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Bulletin 102

ECONOMIC GEOLOGY 15

THE MINING AND QUARRY INDUSTRY

OF

NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1905

BY

D. H. NEWLAND

ALBANY

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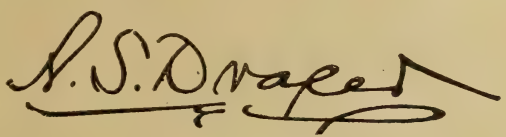
Commissioner of Education

MY DEAR SIR: I beg to communicate herewith for publication as a bulletin of the State Museum a report on *The Mining and Quarry Industry of New York State* for the year 1905, prepared by D. H. Newland, Assistant State Geologist.

Very respectfully
JOHN M. CLARKE
Director

Approved for publication, April 6, 1906



Commissioner of Education

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PREFACE

The present bulletin is similar in plan to the one issued in July 1905, entitled *The Mining and Quarry Industry of New York State.* Its scope has been somewhat enlarged, however, by the inclusion of several additional subjects and by a more comprehensive treatment along some lines where new material has become available since the previous issue. The statistics and notes relating to recent developments have been revised and brought up to date.

Owing to frequent inquiries for such information, it has been deemed advisable to supplement the text with a list of producers in the different departments of mining and quarrying.

In the preparation of the bulletin much assistance has been received from those engaged in the exploitation of the mineral resources of the State, for which it is desired to express grateful acknowledgment.

INTRODUCTION

The mineral resources of New York are the basis of a constantly widening industrial activity. About 30 materials are now commercially exploited, many of them on a large scale, giving the State prominence for its varied and extensive mining industry. While no systematic attempt has been made to ascertain the number of workings (mines, quarries and wells) that are engaged in productive operations, the total may be safely estimated at over 10,000. The aggregate value of their output last year, according to returns received at this office, amounted to $34,663,553.

The valuation given is founded, for the most part, on products in their first marketable forms, and though useful as a standard of comparison it does not adequately represent the relative position or importance of mining in the general economic development. There are many varied industries established for the purpose of elaborating such products by chemical, metallurgical or manufacturing processes, and their welfare is materially promoted by the existence and utilization of the local resources. The reports of the United States Census office for 1900 (the last year for which data are available) state that the industries based primarily on substances taken from mines and quarries contributed a production in that year valued at $492,701,525, which placed New York second among the states in this department of manufacturing. The total was distributed among the different branches as follows: chemicals and applied products, $58,870,609; clay, glass and stone products, $42,594,874; iron and steel and their products, $157,050,481; metals and metallurgical products other than those of iron and steel, $93,341,219; miscellaneous industries, $140,844,342. The value of the products as above stated represented 22.6 per cent of the aggregate reported for all manufactures in New York for that year. It would be of interest to determine the proportion of the products made from local materials, but unfortunately this information can not be had from the reports.

That the mining industry of the State is making good progress is evidenced by the returns received for the last two years, which are embodied in the following pages. The aggregate increase in the values of the products reported last year over the corresponding figures for 1904 amounted to $6,100,958, which is a gain of 21 per cent. Nearly all branches of the industry participated in the advance, showing that it was rather the result of normal growth than of any temporarily favorable conditions in individual lines.

Among the more notable features of the record for 1905 was the

progress reported by the iron-mining industry. The production, which amounted to 827,049 long tons, was the largest since 1892 and represented an increase of 207,946 tons or 34 per cent over the total for 1904. With the exception of the Old Sterling mine which was reopened during the year, there were no changes in the list of producers. The magnetite mines contributed a total of 739,736 tons including 432,867 tons of concentrates. In several instances important improvements have been made to the equipment of the mining plants, and a still further increase in the output may be anticipated for the current year. The Fair Haven Iron Co. has been recently formed to mine ore at Fair Haven, Cayuga county, in the Clinton deposits, and plans are under consideration for the reopening of the Benson mines in St Lawrence county.

The manufacture of clay products is expanding at a rapid rate. The output in 1905 was valued at $14,280,016, a gain of $2,775,312 or 25 per cent during the year. There were 250 plants in operation divided among 45 counties. Building materials (brick, tile, fireproofing and terra cotta) constituted the sum of $11,314,909. The output of brick in the Hudson river region alone numbered 1,219,318,000 valued at $8,191,211. The manufacture of the finer pottery wares, a comparatively recent development in New York, has become of considerable importance, the value of the output of porcelain and semiporcelain (tableware and electric supplies) last year amounting to $1,400,325.

In the quarry industry conditions were more favorable than in 1904, particularly with regard to building materials. The value of the stone products, exclusive of slate and the limestone used in making Portland and natural cements, aggregated $6,107,147, an increase of $937,206 or 18 per cent for the year. The total was distributed according to the various uses, as follows: building stone, $1,488,009; monumental stone, $187,988; curbing and flagging, $1,037,210; crushed stone, $1,902,623; other uses $1,491,317. The growing demand for crushed stone for road and concrete purposes has been one of the leading factors in the expansion of the quarry operations.

The plants manufacturing hydraulic cement reported an output of 4,375,520 barrels, consisting of 2,117,822 barrels of Portland and 2,257,698 barrels of natural rock cement. The industry more than regained the ground lost in the preceding year when it experienced a serious setback due to oversupply and low market prices. The output of Portland cement has grown steadily since the first establishment of plants within the State 25 years ago, and the quantity

reported for 1905 was almost as large as the production of natural rock cement which has had a much longer history.

There was little change in the salt industry during the year; the total of rock and brine salt produced amounted to 8,575,649 barrels or 1,172,591 short tons. This is a decrease of 149,119 barrels from the quantity reported in 1904. The prices obtained for the different grades were, however, above the average, and the value of the output which aggregated $2,303,067 exceeded that of the preceding year by $200,319. A considerable proportion of the salt production is used for the manufacture of soda products.

The mines and quarries of gypsum made an output of 191,860 short tons, a gain of 40,405 short tons for the year. The greater

Mineral production of New York in 1904

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	1 377 302	$1 245 778
Natural rock cement	Barrels	1 881 630	1 207 883
Building brick	Thousands	1 293 538	7 473 122
Pottery	.....	.....	1 438 634
Other clay products	.....	.....	2 592 948
Crude clay	Short tons	8 959	17 164
Emery	Short tons	1 148	17 220
Feldspar and quartz	Long tons	8 703	28 463
Garnet	Short tons	3 045	104 325
Glass sand	Short tons	11 080	8 484
Graphite	Pounds	3 132 927	119 509
Gypsum	Short tons	151 455	424 975
Iron ore	Long tons	619 103	1 328 894
Millstones	.....	.....	21 476
Metallic paint	Short tons	4 740	55 768
Slate pigment	Short tons	3 132	23 876
Mineral waters	Gallons	8 000 000	1 600 000
Natural gas	1000 cubic feet	2 399 987	552 197
Petroleum	Barrels	1 036 179	1 709 770
Pyrite	Long tons	5 275	20 820
Salt	Barrels	8 724 768	2 102 748
Roofing slate	Squares	18 090	86 159
Slate manufactures	.....	.....	7 441
Granite	.....	.....	221 882
Limestone	.....	.....	2 104 095
Marble	.....	.....	478 771
Sandstone	.....	.....	1 896 697
Trap	.....	.....	468 496
Talc	Short tons	65 000	455 000
Other materials[a]	.....	.....	750 000
Total value	.....	.....	$28 562 595

a Includes apatite, carbon dioxid, diatomaceous earth, fullers earth, marl and sand. The value is partly estimated.

part of the increase came from the companies manufacturing wall plaster and plaster of paris.

The combined value of the petroleum and natural gas produced in the State was $2,173,931. The quantity of petroleum made was 949,511 barrels. No noteworthy discoveries of new oil pools were reported, and here is little prospect of there being any marked expansion of the present productive fields in the future. The natural gas industry, however, continues to show progress, due to the active development of the Erie county field. At a value of 23 cents per 1000 cubic feet, the average reported by the principal producing companies, the total quantity of gas produced was 2,639,130,000 cubic feet.

Mineral production of New York in 1905

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 117 822	$2 046 864
Natural rock cement	Barrels	2 257 698	1 590 689
Building brick	Thousands	1 512 157	10 054 597
Pottery	.....	.....	1 621 558
Other clay products	.....	.....	2 603 861
Crude clay	Short tons	6 766	16 616
Emery	Short tons	1 475	12 452
Feldspar and quartz	Long tons	17 000	48 500
Garnet	Short tons	2 700	94 500
Glass sand	Short tons	9 850	7 765
Graphite	Pounds	3 897 616	142 948
Gypsum	Short tons	191 860	551 193
Iron ore	Long tons	827 049	2 192 689
Millstones	.....	.....	22 944
Metallic paint	Short tons	6 059	70 090
Slate pigment	Short tons	2 929	22 668
Mineral waters	Gallons	8 000 000	1 600 000
Natural gas	1000 cubic feet	2 639 130	607 000
Petroleum	Barrels	949 511	1 566 931
Pyrite	Long tons	10 100	40 465
Salt	Barrels	8 575 649	2 303 067
Roofing slate	Squares	16 460	94 009
Slate manufactures	.....	.....	1 000
Granite	.....	.....	253 955
Limestone	.....	.....	2 411 456
Marble	.....	.....	774 557
Sandstone	.....	.....	2 043 960
Trap	.....	.....	623 219
Talc	Short tons	67 000	469 000
Other materials[a]	.....	.....	775 000
Total value	.....	.....	$34 663 553

[a] Includes apatite, carbon dioxid, diatomaceous earth, fullers earth marl and sand. The value is partly estimated.

The mining of graphite is a small but firmly established industry which gives promise of steady growth for some time to come. The graphite obtained from the deposits is of superior grade and is readily marketable. Several new companies are now operating in the Adirondacks, where the main deposits are found. The output of graphite in 1905 amounted to 3,897,616 pounds valued at $142,948.

The talc mines in St Lawrence county supplied 67,000 short tons, about the same quantity as in 1904. The production is governed by the requirements of the paper trade and shows little fluctuation from year to year.

APATITE

Apatite is a crystallized form of calcium phosphate. It contains when pure about 90 per cent of tricalcium phosphate and 10 per cent of calcium fluorid which may be replaced by calcium chlorid. It is a common constituent of igneous and metamorphic rocks, particularly granites, gneisses and crystalline limestones, but it occurs in greater abundance in dikes and veins and in association with iron ores.

The principal uses of apatite are in chemical manufacture for the preparation of phosphoric acid, phosphate of lime and artificial fertilizers. Competition with rock phosphate, which is found in large deposits in many parts of the world, has restricted the mining of apatite, and the output is confined practically to the few localities where it is associated with other valuable minerals. Both apatite and rock phosphate are sold on the basis of content in calcium phosphate (bone phosphate), as determined by chemical analysis. The former ordinarily contains a higher percentage of this component, so that it is preferred for preparations entailing expensive processes of manufacture.

In New York State, apatite has been produced for several years by Witherbee, Sherman & Co., of Mineville. The mineral is disseminated in small grains through the magnetite found at that locality, paricularly in the deposits of the Old Bed group. It frequently forms 5 per cent or more of the ore, in which it is conspicuous by reason of its reddish color. To render the iron ore suitable for smelting, a partial elimination of the apatite is necessary, and this is accomplished by crushing and passing the ore over magnetic machines. Two separations are made, the first yielding a concentrate that carries about 65 per cent iron and a tailings product consisting of magnetite, hornblende, apatite and quartz,

The tailings are again treated on a machine supplied with stronger magnets, which takes out the remaining magnetite as concentrate and the hornblende as middlings product. The tailings from this separation consist of apatite and quartz carrying about 60 per cent of tricalcium phosphate in a marketable form. They are shipped to fertilizer manufacturers. The hornblende middlings also contain 30 or 35 per cent apatite, but they are not utilized to any extent at present. The first separation is made on Ball & Norton endless belt machines and the second on Wetherill machines.

So far as known, the only locality in New York State where apatite occurs in deposits free from admixture with other minerals is near Crown Point, Essex county. The deposit has been described by Emmons[1] who named the mineral eupyrchroite on account of the green phosphorescence which it displayed when heated. An analysis gave about 85 per cent tricalcium phosphate. The deposit consists of botryoid concretionary masses of grayish color and occurs in gneiss near the contact with limestone. It was mined on a small scale about 50 years ago.

The crystalline limestones of the Adirondacks and southeastern New York frequently contain apatite, but the occurrences ar eonly of mineralogic interest. Among the best known localities are Gouverneur and Hammond, St Lawrence co., Natural Bridge, Lewis co., and Amity, Orange co., from which many specimens have been taken for museums.

CARBON DIOXID

Carbon dioxid, or carbonic acid gas as it is commonly called, is produced commercially at Saratoga Springs. It accompanies the mineral waters, issuing in quantity from the wells and natural springs.

The gas is found at depths ranging from 150 to 600 feet. Though its source and the precise conditions under which it accumulates are more or less conjectural, there seems to be little doubt that the productive area lies along a zone of fracture and faulting which involves the sedimentary and underlying crystalline rocks of the region. One marked fault has been traced from Saratoga southwest toward Ballston, approximately in line with the wells.[2] The geologic section includes Potsdam sandstone, resting unconformably upon Precambric gneisses, and Lower Siluric strata as high up as the Utica shale. The general experience in drilling has been that the gas

[1] Geol. N. Y. 2d Dist. 1838. p. 252.
[2] Darton N. H. N. Y. State Mus. Rep't 48, 1894. 2:50,

and mineral waters are stored in limestone below the Utica shale, which indicates a Trenton or possibly Beekmantown (Calciferous) horizon. Wells driven through the limestone into the Potsdam have been weakened in force.[1]

The recovery of the carbon dioxid is a special industry, independent of the production of mineral waters. About 30 wells have been drilled for gas, though not all are used at one time. It is said that the average well yields about 400 pounds of gas daily, with a flow of five or six gallons of water a minute. The yield can be greatly increased by pumping. The larger plants are now supplied with pumping apparatus operated from central stations and connected by pipes with the different wells. The gas is separated from the water at the mouth of the well and is conveyed to a gas holder for storage preparatory to charging into cylinders.

The carbon dioxid as it comes from the well contains a small percentage of impurities, chiefly air, but it is superior in this respect to the gas produced by artificial methods. Hydrogen disulfid is found only in traces. A singular feature is the occasional occurrence of so called " dry wells " which yield little or no water.

The output is shipped to consumers in steel cylinders. Powerful compressors are employed for charging, and the gas is liquefied and maintained in this state until used. It is sold principally to manufacturers of carbonated waters.

There are five companies engaged in the industry. The Natural Carbonic Gas Co. and the Lincoln Spring Co. have plants just outside of Saratoga Springs, while the New York Carbonic Acid Gas Co., the Geysers Natural Carbonic Acid Gas Co. and the Champion Natural Carbonic Acid Gas Co. operate at Geysers, 2 miles southwest of the village.

The average annual production, according to information furnished by J. C. Minor jr, is approximately 4,000,000 pounds. It is estimated that nearly as large a quantity is lost each year by the escape of gas into the air from wells and openings in the vicinity of Saratoga Springs.

CEMENT

Hydraulic cement is manufactured in 10 counties of the State. Crude materials adapted for making both natural and Portland cement are widely distributed, and the development of the manufacturing industry has been governed more by the commercial factors of transportation and proximity to important markets than by any

[1] Minor, J. C. jr. Mineral Industry 1901. 10:772.

limitation of natural resources. In these respects the Hudson river region and the central and western counties along the main trunk lines and the Erie canal possess the greatest advantages. The Hudson river region comprises Ulster county, the largest center of the natural cement industry, and Greene, Columbia, Schoharie and Warren counties which manufacture Portland cement. Among the other counties, Onondaga and Erie have the greater number of plants and their products include both Portland and natural cements. Livingston, Steuben and Tompkins counties, which make Portland cement, complete the list.

Natural cement. New York has long been the leading producer of natural rock cement. The first manufacturing plants were established in Ulster and Onondaga counties soon after 1820. The growth of the industry from the beginning was rapid. By 1840 there were 16 plants in Ulster county in the vicinity of Kingston, Rosendale, Lawrenceville and High Falls, with a total of 60 kilns. The annual production at that time is stated by Mather to have been 600,000 barrels. Owing to its excellent quality, Rosendale cement (the trade name for the product of Ulster county) has been accepted as the standard in all parts of the country. The industry reached its highest point in the period from 1890 to 1900 with an average annual output of 4,000,000 barrels. During the past few years the industry has declined in importance owing to competition with Portland cement.

The rock employed in making natural cement in this State is an impure limestone occurring near the top of the Siluric. In the Rosendale district the cement series includes the Salina, Cobleskill and Rondout beds. At Rondout, according to Van Ingen, there are nine distinct layers or strata aggregating a little more than 30 feet in thickness. The strata have been sharply folded and the methods adopted in their excavation resemble those used in coal mining. In Onondaga county there are two beds of cement rock belonging to the Upper Manlius. The upper layer attains a thickness of 4 feet at the eastern border of the county and is separated from the lower layer which is over 4 feet thick by about 3 feet of blue limestone. The principal quarries are near Manlius, Fayetteville and Jamesville. The cement rock in Erie county is the Bertie waterlime, occurring at the top of the Salina, and has a thickness of 5 to 8 feet. The quarries are located at Akron, Falkirk and Buffalo.

The cement rock varies considerably in chemical composition, but in general it may be described as an impure dolomite or magnesian limestone. The Rosendale rock contains 20 per cent or more of

combined silica, alumina and iron oxid and from 54 to 75 per cent of lime and magnesia carbonates. Analyses of typical cement rock from the quarries at Jamesville, Onondaga co., show about 82 per cent of carbonates and 17 per cent of silicious impurities.

Portland cement. The manufacture of Portland cement in New York has been a development of the last 25 years. The first plant making a commercial product was erected in 1881 by the Wallkill Portland Cement Co., at Carthage Landing, Dutchess co. Limestone from the Helderbergian group and clay were used as ingredients and the cement is said to have been of excellent quality. The successful issue of this venture led to the establishment of a larger plant at South Rondout, which was operated until destroyed by fire in 1889. The first attempt to manufacture Portland cement in the central part of the State was made in 1886 at Warners, Onondaga co. The materials employed were Quaternary clays and marls. This plant, afterward purchased by the Empire Portland Cement Co., has been enlarged and is still active. It was not until about 1890 that the industry began to expand, the output up to that time averaging less than 50,000 barrels annually. In 1890 the production was 65,000 barrels; it increased to 87,000 in 1891, to 124,000 in 1892 and to 137,000 barrels in 1893, since which time its growth has been rapid.

The materials employed by the various companies operating in the State include limestones, marls, clay and shale. The greater number of plants use a mixture of limestone and clay. The limestones are from the Trenton, Helderbergian and Tully formations, while the clays belong to the Quaternary. A mixture of marl and clay is used by four companies. Shale serves as a substitute for clay and is quarried at Ithaca (Hamilton series) and on the Hudson river (Hudson River series). A brief description of the limestones and clays of New York will be found under their proper titles.

Production. There was increased activity during 1905 in cement manufacture in which both the Portland and natural cement works participated. The aggregate production amounted to 4,375,520 barrels valued at $3,637,553. The gain over the previous year, when the total was 3,258,932 barrels valued at $2,453,661, amounted to 1,116,588 barrels or 34 per cent. The production was reported by 21 companies in 1905 and 23 companies in 1904.

The greater part of the increase was contributed by the Portland cement plants which reported a total of 2,117,822 barrels valued at $2,046,864 against 1,377,302 barrels valued at $1,245,778 in the previous year. The production was the largest on record. The

market conditions, both as regards demand and prices, showed material improvement, and the outlook is favorable for even greater progress during the current year. There were nine companies in operation, one less than in 1904. The plant of the Wayland Portland Cement Co., at Wayland, was destroyed by fire in the early part of the year and the company has retired permanently from the business.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1890	65 000	$140 000	3 776 756	$2 985 513
1891	87 000	190 250	3 931 306	3 046 279
1892	124 000	279 000	3 780 687	3 074 781
1893	137 096	287 725	3 597 758	2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689

The production of natural rock cement amounted to 2,257,698 barrels valued at $1,590,689. In 1904 the output was 1,881,630 barrels valued at $1,207,883. Separated as to place of manufacture, the Rosendale district (including Schoharie county) accounted for the larger part of the total, its output having been 1,977,698 barrels valued at $1,472,489 in 1905 and 1,452,516 barrels valued at $1,011,761 in 1904. Erie county produced 203,000 barrels valued at $86,700 against 332,781 barrels valued at $149,112 in the preceding year. The remainder amounting to 77,000 barrels valued at $31,500 in 1905 and 96,333 barrels valued at $47,010 in 1904 came from Onondaga county. There were 12 companies active, a loss of two for the year. The plant of the Cummings Cement Co., at Akron, was closed down for the purpose of making extensive alterations and additions, but it is soon to be reopened. The Potter-Brown Cement Works at Manlius were also inoperative. The property formerly owned by the Jamesville Milling Co. has been taken over by the Thomas Millen Co., of Wayland.

Bibliography

Eckel, E. C. Cement Materials and Industry of the U. S. U. S. Geol. Sur. Bul. 243. Wash. 1905.
Lewis, F. H. Manufacture of Hydraulic Cement in the U. S. The Mineral Industry. v.6. 1897.
Ries, H. & Eckel, E. C. Lime and Cement Industries of N. Y. N. Y. State Mus. Bul. 44, 1901.

CLAY

The manufacture of brick and other clay products is the most important branch of the mineral industry in New York. Clay deposits suitable for making the common wares are distributed throughout every section in practically inexhaustible quantities. The rapidly growing market for these products has led to the establishment of numerous manufacturing plants in recent years, so that now there is scarcely an industrial center of any size in which they are not produced. This is particularly true with regard to the manufacture of building materials, which are being employed more and more widely as an element in permanent construction. Owing to their cheapness, durability and the convenience with which they can be adapted to meet the varied architectural requirements, the use of these materials will doubtless continue to expand for a long time to come.

The manufacture of the finer grades of clay wares has not developed so rapidly as the other lines. In contrast with most of the states along the Atlantic seaboard, New York possesses almost no deposits of kaolin in quantity to be of economic value. This fact has hitherto retarded the establishment of industries in which kaolin is employed, but with improved facilities of transport, the deficiency has become less formidable to local manufacturers. There are now several plants in the State making tableware, electrical supplies and other porcelain and semiporcelain wares.

Occurrence and character of clays

The distribution of clays in New York, as well as their character, uses and industrial development, has been fully described in a report by Heinrich Ries to which reference will be found under the bibliography. The following résumé is largely based on data contained in that report.

The soft plastic clays, as distinguished from shale, have been deposited in the more recent geologic periods, ranging from Cretaceous to the present. The period of most abundant deposition is the Quaternary, to which age belong all the clays of the mainland so far as known. Cretaceous clays have a limited distribution on

Long Island and Staten Island, and a few deposits on the north shore of Long Island have been referred to the Tertiary.

The Quaternary deposits have been formed under various conditions, but are more or less directly the result of glacial action at the time when this region was invaded by the continental ice sheet. Some are of morainal character and were laid down under the ice or at the ice front. They consist of stiff clay in unstratified masses mixed with boulders, often of large size, that have been ground and polished by erosion. Such deposits have not been utilized to any extent except in one or two localities, owing to their usually limited occurrence and the difficulties involved in their treatment.

Most of the clay beds that are exploited are of glacial origin, but modified by the sorting action of water. They occur frequently in valley bottoms in basin-shaped areas which are the sites of lakes and ponds formed temporarily by the damming of the natural drainage by the ice sheet or moraines left on its retreat. The beds range from a few feet up to 50 feet in thickness and rest on glacial drift or bed rock. They are normally of blue color, but the upper portion may be weathered to yellow. Beds of sand and gravel are frequently interstratified with them. In the Hudson and Champlain valleys which were once occupied by large glacial lakes, clay deposits occur in terraces extending several hundred feet above the present sea level. The clay and accompanying sands were contributed by the streams that flowed into these lakes.

Long Island. Clay beds outcrop along the north shore and at several points on the main line of the Long Island railroad. The most western occurrence is on Elm point, near Great Neck, where there is a bed of stoneware clay 30 feet thick overlain by gravel and drift. It resembles the Cretaceous clays of New Jersey and probably belongs to this series. Deposits of similar character are found on the east shore of Hempstead harbor, at Glen Cove and vicinity, on Center island in Oyster bay, on Little Neck in Northport bay, and at other localities. The Cretaceous clays are adapted for stoneware and coarser pottery, as well as for brickmaking. Common brick clays extend almost the entire length of the island. They are worked at Garden City, East Williston, Farmingdale, Port Jefferson, Southold and Greenport.

Staten Island. Important deposits of Cretaceous age are found in the southern part of the island. They are of varied quality, some grades being white and approaching kaolin in composition.

The latter have been employed largely in the manufacture of terra cotta. A plant producing this material is located at Tottenville. Fire brick and pressed brick are made at Kreischerville and common brick at Green Ridge.

Hudson valley. The clays of this region are of great economic value. They are found on either side of the river, as far south as Rockland and Westchester counties, in terraced deposits arranged at elevations up to 300 feet or more above sea level. They are usually overlain by delta sands and gravels with a soil capping. The workable beds attain a thickness in some instances of 100 feet. Thin layers of sand alternate with the clay and the whole series is well stratified. The clay normally has a blue color, but where unprotected by overlying beds it is weathered to yellow, the weathering often extending to a depth of 15 feet. The oxidation of the iron components which produces this change is facilitated by the sandy loosely textured nature of the upper beds which permits the percolation of water from the surface. The blue clay is more plastic than the yellow, and both contain from 3 to 6 per cent lime carbonate, thus belonging to the class of marly clays.

The Hudson river deposits are employed solely in brickmaking. There are over 100 plants engaged in this industry and the annual output amounts to more than 1000 million brick. Some of the leading centers of manufacture are Haverstraw, Croton, Stony Point, Verplanck, Peekskill, Cornwall, New Windsor, Dutchess Junction, Fishkill, Roseton, Poughkeepsie, Kingston, Saugerties, Catskill, Hudson and Albany.

Lake Champlain. The deposits are somewhat similar to those in the Hudson valley. Terraces occur along the lake from Whitehall, at the southern end, to beyond the limits of New York State. They are of variable width, narrowing southward, where the Adirondack ridges rise steeply almost from the shore line. At the lower end of the lake the deposits are largely of marine character and were laid down on the receding shores of the sea which invaded the region after the withdrawal of the glacial waters. At Beauport and Port Kent the section shows yellowish brown sand, yellowish brown clay and stiff blue clay, the latter being calcareous. The formation has a thickness of 15 feet. The clays are used for brick, principally around Plattsburg.

Interior of the State. Clay beds are widely distributed, but their economic utilization is confined mostly to the vicinity of the larger towns and cities.

In the western part of the State there are deposits in Buffalo and vicinity which are the basis of an extensive manufacturing industry. The clay rests upon bed rock, varying from a few inches to 60 feet in thickness. A section on Grand island showed 20 feet of red clay and 14 feet of boulder clay. The beds occur also at Tonawanda and La Salle and south of Buffalo along the shore of Lake Erie. Common building brick is the leading product, but pressed brick, hollow brick, earthenware and tile are manufactured on a small scale.

Clay is worked at Jamestown and Dunkirk, Chautauqua co. At the latter locality the deposit is 20 feet thick, consisting of yellow sandy clay on top and blue clay underneath.

Around Rochester clay is found in an area extending 7 miles north and south and about 10 miles east and west, in the towns of Brighton, Henrietta and Chili. It is usually of reddish color and has an extreme depth of 10 or 12 feet. The main openings are in the suburbs of Rochester. Common brick, fire brick, building tile, fireproofing and drain tile are made.

The clay beds of Onondaga county occur in the valleys throughout the central and southern portions. Many of them are reddish in color, evidently due to their derivation, in part at least, from the Salina shales. A large deposit of stiff red clay occurs at the south end of Onondaga valley, in the vicinity of the salt wells. On the east bank of the Seneca river, east of Baldwinsville, there are openings which yield blue and buff clays. The thickness exposed ranges from 15 to 25 feet. Some pottery clay has been obtained at Belle Isle, a few miles west of Syracuse. The clay products of the county include building brick, paving brick, hollow building blocks, drain tile and earthenware. There are potteries at Syracuse manufacturing porcelain and china wares, but the crude materials are obtained elsewhere.

In Jefferson and St Lawrence counties scattered deposits of clay occur and are worked for brick around Watertown, Carthage and Ogdensburg. At Watertown a bed 20 feet thick consists of red and gray clay resting on Trenton limestone.

Along the Mohawk valley clay beds are found at frequent intervals from Rome to Schenectady. They have a thickness of from 6 to 15 feet and are red, blue or gray in color. They are utilized to supply the local markets with building brick.

In the southern part of the State the clays are of comparatively little economic importance. A small output of building brick is

made from local deposits at Binghamton, Horseheads, Ithaca and a few other localities.

Utilization of shale

Though lacking the natural plasticity of clays, shale serves equally well for manufacturing most of the common wares. Its employment has been introduced quite recently, but it has given such satisfactory results that an enlarged development may be expected in the future. There are immense deposits of this material in New York State.

The principal shale-bearing formations belong to the Devonic and include the Hamilton, Portage and Chemung groups. The Salina, Clinton and Medina groups of the Upper Siluric likewise inclose extensive beds, while of the Lower Siluric may be mentioned the Hudson River shale which in age ranges from the middle Trenton to the Lorraine.

The Devonic shales outcrop over the central and southern parts of the State, between the Hudson river and Lake Erie. They are somewhat silicious and alternate with thinly bedded sandstones. Among the localities where they are worked are Angola and Jewettville, Erie co.; Jamestown, Chautauqua co.; Alfred Center, Allegany co.; and Corning, Steuben co. The products include common and pressed brick, fire brick, terra cotta, roofing tile, drain tile and hollow building blocks.

Production of clay materials

The returns received from the manufacturers of clay materials for the year 1905 show that the output was by far the largest ever made in New York State. The aggregate value of the production amounted to $14,280,016. There were 250 plants engaged in the industry, distributed over 45 counties.

Compared with the production in 1904 which was valued at $11,504,704, the increase for the year was $2,775,312 or nearly 25 per cent. The large gain may be ascribed rather to the more active operations carried on by the companies than to additions to the number of plants, as there were only five more reporting a production than in the preceding year.

Of the various materials produced, common building brick accounted for more than one half of the total value. The product was valued at $9,751,753, as compared with $7,234,876 in 1904. Front brick and fancy building brick aggregated $302,844, as compared with $238,246; vitrified paving brick $180,004, against

$210,707, and fire brick and stove lining $498,184, against $506,800. The manufacture of drain tile amounted to $146,790, against $149,864, and sewer pipe to $444,457, against $460,000. The product of terra cotta was valued at $874,717, as compared with $798,028 in 1904; fireproofing at $133,995, as compared with $157,119; and building tile at $251,600, as compared with $206,503. In addition there were produced miscellaneous materials, including flue lining, fire tile and shapes, conduit pipes, sidewalk brick and acid-proof brick, the collected value of which amounted to $74,114, against $103,927 in 1904. The potteries of the State reported an output valued at $1,621,558, as compared with $1,438,634 in the preceding year.

Production of clay materials

MATERIAL	1904	1905
Common brick	$7 234 876	$9 751 753
Front brick	238 246	302 844
Vitrified paving brick	210 707	180 004
Fire brick and stove lining	506 800	498 184
Drain tile	149 864	146 790
Sewer pipe	460 000	444 457
Terra cotta	798 028	874 717
Fireproofing	157 119	133 995
Building tile	206 503	251 600
Miscellaneous	103 927	74 114
Pottery	1 438 634	1 620 558
Total	$11 504 704	$14 280 016

The distribution of the production according to the counties in which it was made shows that Rockland county has the largest clay-working industry. The value of its output last year was $2,144,210. In 1904 it also led the list with an aggregate value of $1,422,436. Ulster county maintained its position as the second largest producer, with a total valued at $1,776,035, as compared with $1,274,284 in the preceding year. Dutchess county, which held third place in both years, reported a product valued at $1,258,937 against $932,907 in 1904. Orange county ranked fourth with an output valued at $1,011,006, while in 1904 it was fifth with $690,064. The importance of the industry in these counties is due to the extensive manufacture of building brick, which are supplied to the New York city market. On the other hand, Onondaga county, which was the fifth largest producer last

year with an aggregate value of $932,285, is chiefly represented by pottery. The other counties that reported a production of over $500,000 in 1905 are Erie ($700,527), Richmond ($645,367), Monroe ($644,411), Albany ($624,238), Westchester ($592,705), Kings ($565,888), and Columbia ($520,500).

Production of clay materials by counties

COUNTY	1904	1905
Albany	$648 973	$624 238
Allegany	127 552	118 989
Broome	22 000	18 000
Cayuga	24 520	25 920
Chautauqua	83 405	78 130
Chemung	96 300	96 000
Clinton	5 000	5 900
Columbia	420 500	520 500
Dutchess	932 907	1 258 937
Erie	647 334	700 527
Fulton	4 000	1 700
Greene	232 924	389 562
Jefferson	30 467	36 502
Kings	539 288	565 888
Madison	16 400	12 000
Monroe	658 058	644 411
Nassau	52 644	76 992
Niagara	16 892	3 272
Oneida	145 880	133 250
Onondaga	916 954	932 285
Ontario	245 743	345 250
Orange	690 064	1 011 006
Rensselaer	257 751	263 256
Richmond	488 873	645 367
Rockland	1 422 436	2 144 210
Saratoga	331 360	362 268
Seneca	19 175	3 525
Steuben	176 613	164 663
Suffolk	86 112	113 000
Tompkins	17 715	15 004
Ulster	1 274 284	1 776 035
Warren	28 625	45 712
Washington	15 755	20 270
Westchester	354 705	592 705
Other counties[a]	473 495	534 742
Total	$11 504 704	$14 280 016

[a]Includes Genesee, Lewis, Montgomery, New York, Queens, St Lawrence, Schenectady Wayne and Wyoming counties. Lewis county reported no production in 1905.

Manufacture of building brick

The output of common building brick in 1905 amounted to 1,493,459,000, valued at $9,751,753. In addition there were manufactured 18,698,000 front and fancy pressed bricks, valued at

$302,844, making a total output of brick used for building purposes of 1,512,157,000 valued at $10,054,597. The total quantity manufactured in the preceding year was 1,293,538,000, valued at $7,473,122. The manufacture of these materials was carried on in 39 counties by a total of 192 plants. In the preceding year there were 37 counties represented, with a total of 187 plants. The average price received for common brick last year was $6.53 a thousand

Production of common building brick

COUNTY	1904		1905	
	Number	Value	Number	Value
Albany	78 500 000	$462 973	66 500 000	$439 238
Allegany	1 516 000	9 098	1 092 000	6 957
Broome	4 000 000	22 000	3 000 000	18 000
Cayuga	3 320 000	20 920	3 416 000	21 520
Chautauqua	6 619 000	39 539	8 885 000	49 992
Chemung	15 500 000	95 000	15 600 000	96 000
Clinton	1 000 000	5 000	1 100 000	5 900
Columbia	73 280 000	420 500	84 750 000	520 500
Dutchess	167 299 000	932 707	181 683 000	1 258 937
Erie	62 286 000	292 448	54 269 000	282 859
Greene	38 051 000	232 924	55 719 000	377 470
Jefferson	4 577 000	30 467	4 900 000	36 502
Madison	400 000	2 400	Nil	.....
Monroe	22 394 000	129 030	24 176 000	139 320
Nassau	7 600 000	47 644	8 240 000	58 872
Niagara	2 852 000	16 892	*a*.....	*a*.....
Oneida	18 880 000	85 880	17 046 000	86 769
Onondaga	20 750 000	120 017	16 889 000	104 134
Ontario	2 618 000	15 738	3 000 000	18 000
Orange	121 803 000	690 064	160 530 000	1 011 006
Rensselaer	17 232 000	85 964	25 250 000	133 350
Rockland	239 813 000	1 422 436	302 625 000	2 144 210
St Lawrence	600 000	3 000	600 000	4 200
Saratoga	58 070 000	284 561	62 335 000	319 569
Seneca	2 025 000	10 175	50 000	400
Steuben	4 485 000	35 858	2 000 000	21 300
Suffolk	15 050 000	83 112	17 250 000	110 000
Tompkins	2 720 000	16 340	2 021 000	15 004
Ulster	219 106 000	1 274 284	265 368 000	1 776 035
Warren	5 724 000	28 625	8 763 000	45 712
Washington	1 275 000	7 000	2 300 000	11 800
Westchester	51 234 000	287 295	76 893 000	530 465
Other counties *b*	5 280 000	24 979	17 209 000	107 732
Total	1 275 859 000	$7 234 876	1 493 459 000	$9 751 753

a Included under "other counties."
b Includes in 1904 the following: Fulton, Lewis, Montgomery and Wayne. In 1905 the following are included: Fulton, Herkimer, Livingston, Montgomery, Richmond, Tioga and Wyoming.

and for front brick $16.20, which compare with $5.67 and $13.48, the respective averages for 1904.

Hudson river region. The counties along the Hudson river are the largest producers of building brick in the State. Owing to the extensive market afforded by New York city and the low costs of transport by river, the industry in this section is exceptionally

Output of brick in the Hudson river region in 1904

County	Number of plants	Output	Value	Average price per M
Albany	8	78 500 000	$462 973	$5 90
Columbia	4	73 280 000	420 500	5 74
Dutchess	17	167 319 000	932 907	5 58
Greene	4	38 051 000	232 924	6 12
Orange	9	121 803 000	690 064	5 67
Rensselaer	6	17 232 000	85 964	4 98
Rockland	34	239 813 000	1 422 436	5 93
Ulster	21	219 106 000	1 274 284	5 82
Westchester	7	54 734 000	324 045	5 92
Total	110	1 009 838 000	$5 846 097	$5 79

Output of brick in the Hudson river region in 1905

County	Number of plants	Output	Value	Average price per M
Albany	8	66 500 000	$439 238	$6 61
Columbia	5	84 750 000	520 500	6 09
Dutchess	17	181 683 000	1 258 937	6 93
Greene	7	55 719 000	377 470	6 77
Orange	12	160 530 000	1 011 006	6 67
Rensselaer	8	25 250 000	133 350	5 28
Rockland	31	302 625 000	2 144 210	7 08
Ulster	23	265 368 000	1 776 035	6 69
Westchester	8	76 893 000	530 465	6 90
Total	119	1 219 318 000	$8 191 211	$6 54

situated so far as commercial conditions are concerned. There is probably no other region in the world where the manufacture of brick has attained to similar proportions. The counties included in this region are Rensselaer, Albany, Columbia, Greene, Ulster, Dutchess, Orange, Rockland and Westchester. With the excep-

tion of Albany and Rensselaer, which probably consume the greater part of the local product, their output is marketed almost entirely in New York city.

In 1905 the output of the plants in this section aggregated the enormous total of 1,219,318,000, or approximately 82 per cent of the production of common building brick in the entire State. The gain over the preceding year was 209,480,000 or about 20 per cent. There were 119 plants reporting as active, an increase of nine for the year. Rockland county was represented by the largest number, 31, while Ulster was second with 23 and Dutchess third with 17. The average number of brick made in each plant was 10,246,000, as compared with 9,180,000, the average for 1904. The price for the whole region averaged $6.54 a thousand, against $5.79 a thousand in 1904.

The large production of the plants during the past year was due to the unprecedented demand for building brick in the New York city market. The consumption was so active that practically the entire output of the region was exhausted by the opening of winter, and much brick was brought in from the interior of the State.

Other clay materials

The manufacture of paving brick was carried on during 1905 in Chautauqua, Greene, Onondaga, Saratoga and Steuben counties. There were six companies engaged in the business and the output was 13,984,000 valued at $180,004. In 1904 there were eight companies which reported an output of 16,351,000, valued at $210,707.

Fire brick and stove lining were manufactured in Albany, Chautauqua, Erie, Kings, Oneida, Rensselaer, Richmond, Schenectady, Washington and Westchester counties by 13 companies. The output represented a value of $498,184, against $506,800 in 1904 when there were 14 companies active.

Drain tile and sewer pipe were manufactured in Albany, Cayuga, Chautauqua, Erie, Genesee, Monroe, Oneida, Onondaga, Ontario, Saratoga, Seneca, Washington and Wayne counties. The output of drain tile was valued at $146,790, against $149,864 in 1904; and sewer pipe at $444,457 against $460,000. There were 24 companies engaged in this branch of the industry, a loss of three as compared with the previous year.

Terra cotta, fireproofing and building tile were produced in Albany, Allegany, Chautauqua, Erie, Genesee, Kings, Monroe, New York,

Onondaga, Queens, Rensselaer, Richmond and Steuben counties, by a total of 20 companies, or four more than in the preceding year. The production of terra cotta was valued at $874,717, against $798,028 in 1904; fireproofing at $133,995 against $157,119; and building tile at $251,600 against $206,503.

Pottery

The grades of pottery made in New York range from common earthenware to porcelain. The manufacture of the finer wares is a relatively recent development, and it is only in the last year or two that the output has attained importance. The fact that many of the raw materials which enter into their manufacture are not found in the State, no doubt has retarded the progress of that branch of the industry. This advantage is offset, partially at least, by better market facilities than can be had in most sections of the country, and with low transport rates local manufacturers are not seriously handicapped in the competition for trade.

The kaolin used in the potteries is supplied from New Jersey and England. Most of the feldspar comes from Canada, though this material is produced to some extent in Westchester county. The pottery clays are brought from New Jersey, but a small quantity is obtained at Belle Isle, Onondaga county. The slip clay is mostly from Albany county.

The production of pottery for 1905 as shown in the accompanying table amounted in value to $1,620,558. In the preceding year the output was valued at $1,438,634. The increase of $181,924 was principally represented in the high-grade products, those of porcelain and semiporcelain, though there was a small gain also in the production of stoneware. The products listed in the table as miscellaneous include yellow and Rockingham wares, clay tobacco pipes, fire clay crucibles and artistic pottery.

The 22 companies that contributed to the output each year are disributed among the following counties: Albany, Erie, Kings, Madison, Nassau, Oneida, Ontario, Schenectady, Suffolk, Washington and Wayne. The single plant in Monroe county which reported a production in 1904 was inactive last year. Onondaga county has the largest industry, with an output valued at $718,985 in 1905 and $673,590 in 1904, made by five companies. Kings county with six companies ranks second, its product being valued at $308,443 in 1905 and $279,009 in the preceding year.

Value of production of pottery

Ware	1904	1905
Stoneware	$77 726	$115 890
Red earthenware	44 490	30 740
[a]Porcelain and semiporcelain	740 000	800 000
Electric and sanitary supplies	490 095	600 325
Miscellaneous	85 823	73 603
Total	$1 438 634	$1 620 558

[a] Includes china tableware.

Crude clay

In the foregoing tables relating to clay products no account has been taken of the crude clay entering into their manufacture. There are a few producers in the State which do not utilize the crude clay themselves, but ship it to plants at other localities. Some of the material, like the Albany slip clay for example, is even forwarded to points without the State. For 1905 returns have been received from nine firms engaged in this industry whose total shipments amounted to 6766 short tons, valued at $16,616. Of this quantity 3005 tons, valued at $11,886, consisted of slip clay from Albany county. The corresponding figures for the preceding year were 8959 tons valued at $17,164, of which 3228 tons, valued at $9630, was slip clay.

Bibliography

Beck, Lewis C. Mineralogy of New York. 1842.
Hall, James. Survey of the 4th Geological District. 1843.
Luther, D. Dana. Geology of Onondaga county. N. Y. State Mus. 49th An. Rep't. v.2. 1898.
Mather, W. W. Geology of New York. Report on First District. 1843.
Nason, F. L. Economic Geology of Albany county. N. Y. State Mus. 47th An. Rep't. 1894
Ries, H. Clays of New York; their Properties and Uses. N. Y. State Mus. Bul. 35. 1900.
Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. N. Y. State Mus. Bul. 48. 1901.

DIATOMACEOUS EARTH

Diatomaceous earth is an accumulation of the silicious skeletons of microscopic organisms known as diatoms. Deposits are found on the sites of former lakes, the waters of which were inhabited by these organisms, and are also being formed on the bottoms of existing ponds and lakes. The purer varieties of diatomaceous earth which have commercial application contain 85 per cent or more of

silica, and usually less than 2 per cent of combined iron oxids, alumina and lime, the remainder being water.

Diatomaceous earth occurs at several localities in New York State, but the only deposit that has been worked of late years is that near Hinckley, Herkimer co. A bed from 2 to 30 feet thick forms the bottom of White Lead lake, covering an area of about 4 acres. It is under 4 feet of water. The material is excavated and purified by washing and settling in vats, after which it is compressed into cakes. The main use of the earth is in the manufacture of polishing powders. The single producer is George W. Searles of Herkimer. An analysis shows the following chemical composition:

Silica (SiO_2)	86.515
Alumina (Al_2O_3)	.449
Ferric oxid (Fe_2O_3)	.374
Lime (CaO)	.120
Water and volatile matter	12.120
Undetermined	.422
	100.000

In township 43, Herkimer county, there are a number of ponds and lakes containing diatomaceous earth in beds of varying thickness. A detailed description will be found in a paper read before the New York Academy of Sciences by Charles F. Cox, to which reference is made under the appended bibliography. In all, eight localities are named by Mr Cox, the list including Roilly pond, Big Crooked lake, Chub pond, Hawk lake and other smaller bodies of water. An area of from 1 to 5 acres of the material was found in each locality and soundings showed a thickness up to 20 feet or more. The earth is said to be very pure.

Bibliography

Merrill, F. J. H. Mineral Resources of New York State. N. Y. State Mus. Bul. 15, p.555.
Cox, Charles F. N. Y. Acad. Sci. Trans. 1893. 13:98.

EMERY

Deposits of emery are found in Westchester county, southeast of Peekskill. The mines, which were first opened for iron ore, occur along the contact of basic igneous intrusions belonging to the gabbro series. They are mostly shallow and ordinary quarry methods are employed in extracting the material.

The emery is composed of corundum, magnetite and hercynite (iron-aluminum spinel) in varying proportions. According to the investigations of Magnus, hercynite is the most prominent constituent and constitutes in some cases 50 per cent of the mass. It has a hardness of 8, as compared with 9 for corundum. The magnetite forms minute inclusions in the hercynite crystals. The latter have a distinct cleavage which adds to the abrasive qualities.

The material is broken in the quarry by light charges of explosives, and is then roughly cobbed and sent to the mill. As much as 100 tons have been taken from a single opening. The preparation at the mill consists in breaking down the emery by passing through crushers and rolls until of suitable size. The emery is then passed through washers, after which it is dried and graded. The screens used in grading range from 14 to 180 meshes to the square inch. The product is employed in making emery paper and cloth and emery wheels.

The production of emery in 1905 amounted to 1475 short tons valued at $12,452. A part of this quantity was held in stock at the mines, the total shipments from the region being 1158 tons. In the preceding year the output was 1148 short tons valued at $17,220. There were four concerns engaged in mining during 1905.

Bibliography

Magnus, Harry C. Abrasives of New York State. N Y. State Geol. 23d An. Rep't. 1904.

Nevius, J. N. Emery Mines of Westchester county. N. Y. State Mus. 53d An. Rep't. 1901.

FELDSPAR

Feldspar suitable for pottery purposes is obtained near Bedford, Westchester county. It occurs in pegmatite dikes intersecting the crystalline rocks of that region and is associated with quartz, mica and tourmalin. In some of the dikes the feldspar forms large masses or anhedra, quite free from impurities, while in others it is intergrown with quartz; only the former occurrences, however, have commercial value. The feldspar belongs to the variety known as orthoclase, which is characterized by a high potash content. It varies from dark red to white in color.

The Bedford quarries have been worked since 1878. The output is shipped mostly to pottery manufacturers at Trenton, N. J.

Pegmatite dikes are an important feature of the geology of the Adirondacks, being particularly abundant along the borders where they are associated with Precambric gneisses. Some of the occur-

rences in this region have been exploited for a time with apparently successful results, but the quarries are now abandoned. A quarry known as Roe's "spar bed" is found near Towner pond in the town of Crown Point, Essex co. The feldspar occurs in large masses of pinkish color and seems to be of good quality. It contains, however, scattered crystals of black tourmalin which may have interfered with its use for pottery purposes. Another quarry was opened in 1900 near Ticonderoga. The deposit is said to range from 10 to 40 feet in width and to carry 75 per cent feldspar, 20 per cent quartz and 5 per cent mica.

The chemical composition of the Bedford feldspar is shown by the following analyses:

	1	2
Silica (SiO_2)	64.97	65.85
Alumina (Al_2O_3)	20.85	19.32
Ferric oxid (Fe_2O_3)	trace	.24
Lime (CaO)	.....	.56
Magnesia (MgO)	.....	.08
Potash (K_2O)	13.72	14.10
Moisture (H_2O)	.46	.....
	100.00	100.15

FULLERS EARTH

Fullers earth has been obtained in past years near Rome, Oneida co. The deposit is described by H. Ries[1] as occurring 12 miles north of that city, on the line of the Rome, Watertown & Ogdensburg railroad. It is a fine grained, dense, Quaternary clay occurring in layers 2 to 8 inches deep, interbedded with equally thick layers of sand. The total thickness exposed is about 15 feet, and there is a capping of about 4 feet of sand. In mining, the overlying sand is removed and the layers of fullers earth taken out successively as they are reached. The earth is placed on racks for sun drying. It is employed for cleansing woolen goods and has been shipped to factories in New York and neighboring states.

GARNET

The use of garnet as an abrasive has given rise to a small but firmly established industry in the Adirondack region. The variety of garnet produced is almandite, which is a silicate of aluminum

[1]N. Y. State Mus. Bul. 35. 1900. p. 848-51.

and iron. It has a hardness ranging from 7.5 to 8, above the average for this mineral, and is thus intermediate between quartz (7) and corundum (9). For some purposes the Adirondack garnet is even preferred to corundum, though the latter commands a higher price in the market.

The deposits at present worked are found in Warren and Essex counties near the upper Hudson valley. North Creek, the terminus of the Adirondack branch of the Delaware & Hudson railroad, is the principal point of shipment. The mines are situated north and west of this locality within an area 10 or 12 miles long extending north from Gore mountain.

The garnet is usually associated with a basic hornblende rock or amphibolite which forms bands and lenses in the more acid gneiss that constitutes the country rock of this region. The amphibolite shows evidences of metamorphism which has brought about a recrystallization of its minerals and has probably led to the formation of the garnet. The latter occurs in crystals, ranging from an inch or less up to several feet in diameter. It has a deep reddish color. The larger individuals seldom show crystal boundaries and are so shattered that they readily crumble into small fragments. They usually contain a small proportion of quartz, mica and other minerals that have been included during crystallization.

Ordinary quarry methods are used in working the deposits. The rock is broken down by pick or by blasting and the garnet recovered by hand sorting or mechanically. The North River Garnet Co. has the only plant for mechanical treatment of the rock, which consists in passing it through crushers and concentrating on special types of jigs. The separation is a matter of some difficulty as the garnet and the accompanying hornblende differ but little in specific gravity. The process developed by this company has been, however, very successful.

Most of the output of garnet is consumed in the shoe and woodworking industries, for which purposes it is graded into various sizes and made into garnet paper. Although garnet does not possess the property of cleavage, there is a tendency to parallel parting which is very marked in the Adirondack mineral. This is of great advantage to the use of garnet as an abrasive, as it gives a smooth surface for attachment to the paper and also insures a sharp cutting edge. The efficiency of garnet paper under the usual conditions is stated to be several times greater than the best sandpaper. Inferior grades of garnet mixed with emery or corundum have been employed in making abrasive wheels.

The North River Garnet Co. has opened a new deposit on Thirteenth lake, 7 miles southwest of North River, which was operated for the first time during the past year. A large mill has been erected near the mine. The old workings in the town of Minerva, just west of North River, have been abandoned. The garnet of the former locality occurs in a basic rock which appears to belong to the gabbro series and thus differs in its association from the usual occurrences in that vicinity. The principal constituents are lime-soda feldspar and hornblende. The feldspar belongs to a basic variety of plagioclase, probably anorthite. Orthorhombic pyroxene (bronzite), biotite and small quantities of quartz are also present. The pyroxene is largely altered to chlorite.

The deposits on Gore mountain have been worked for many years and are very extensive. They occur along the northern face of the mountain at an elevation of about 2800 feet. They have been opened at several points along the strike, but so far hardly more than the superficial portions have been removed. Their thickness exceeds 100 feet in places. H. H. Barton & Son is the only company that operated at this locality during the year.

On Garnet peak, a prominence about 3 miles from North River on the road leading to Indian Lake, there are several mines that are worked intermittently by small operators.

Some interest has been shown during the year in a deposit of different type than those described. The locality is on the eastern slope of Mt Bigelow, 5½ miles south of Keeseville, in northern Essex county. The country rock is anorthosite, a part of the great mass of that rock which is exposed in the central Adirondacks. It is made up of granular feldspar with a little pyroxene, biotite and garnet and has a more or less laminated appearance. In the vicinity of the garnet deposit the rock shows considerable variation due to included bands of amphibolite and pegmatite. The garnet does not form crystals, but occurs in irregular and lens-shaped bodies of massive character that are apparently in direct contact with the anorthosite. Except for admixture with small greenish crystals of pyroxene the garnet is quite pure. At one locality there is an almost continuous series of outcrops extending north and south for a distance of 400 feet. The greatest thickness shown is about 40 feet. The garnet usually has a finely granular texture and readily crumbles under slight pressure, but occasionally it is platy and breaks with a smooth surface. Its origin is probably to be explained by alteration, similar to that which has given rise to the amphibolite bands, which have been caught up during the intrusion

of the anorthosite or have been folded into the latter and metamorphosed. Impure limestone would afford the necessary constituents for its formation. The deposit is owned by G. W. Smith of Keeseville. Nothing more than exploratory work was done during the year.

The output of garnet by mines in New York State amounted to 2700 short tons, valued at $94,500 in 1905 as compared with 3045 short tons valued at $104,325 in the previous year. The decrease was incidental to the short season of operations. The output, however, was larger than the average of a number of years past.

Bibliography

Hooper, F. C. The American Garnet Industry. Mineral Industry. 1898. v.6.

Merrill, F. J. H. Mineral Resources of New York. N. Y. State Mus. Bul. 15. 1895.

Magnus, H. C. Abrasives of New York State. N. Y. State Geol. 23d An. Rep't. 1904.

GRAPHITE

The mining of graphite has shown encouraging progress during the past year. The output was larger than ever before due to the additional supply from mines that have recently entered upon the productive stage, and unusual interest has been shown in prospecting for new deposits, in some cases leading to promising developments. A continued advance may be anticipated for the industry. There is a large and growing market for the better grades of graphite that is capable of absorbing many times the present output. The product from the New York State mines is all of the crystalline variety, the consumption of which is at present supplied mostly by imports from foreign countries.

Graphite deposits are widely distributed in the Adirondack region. As shown by Professor Kemp,[1] they accompany the metamorphosed Precambric (Algonkian) strata and according to their associations can be divided into four classes. These are (1) pegmatite dikes, (2) veinlets of graphite, (3) quartzites, (4) crystalline limestones with their included gneissoid rocks.

The pegmatite dikes or veins are found cutting the gneisses and limestones. They yield a coarsely crystalline graphite which is sometimes distributed in flakes through the gangue and in other cases is aggregated in large bunches quite free from admixture. Though they have the appearance of exceptional richness, the deposits are so irregular in their content and so uncertain in their continuity

[1] Kemp, J. F. Graphite in the Eastern Adirondacks. U. S. Geol. Sur. Bul. 225. 1903.

that they seldom afford a basis for extensive mining operations. The only occurrence of this character that has attained any economic importance is the mine on Chilson hill near Ticonderoga, owned by the American Graphite Co. The mine has been shut down for the past 40 years. The deposit was not exhausted, but the great depth attained together with the large influx of water prevented profitable exploitation. The character of the pegmatite varies in different places. Feldspar and quartz are the most common constituents, while pyroxene, hornblende, mica, scapolite, calcite and other minerals may be present. Owing to the coarse texture of the materials the separation of the graphite ordinarily involves less difficulty and expense than the usual type of deposit from which the present output is obtained.

Small veins of graphite of comparative purity are sometimes found in the Adirondacks. The most notable occurrence is at Split rock, south of Essex, Essex co., where there are several such veins filling fissures in gneiss. The veinlets average less than an inch in width and contain considerable quartz. They are not of sufficient extent to repay working.

The graphitic quartzites have proved so far to be the most valuable sources of the mineral in the Adirondack region. They represent ancient sedimentary rocks of the nature of sandstones which have undergone metamorphism and recrystallization. They occur principally on the borders of the region in scattered areas, which are undoubtedly the remnants of a once extensive formation now largely removed by erosion. Besides quartz, there is usually some feldspar present, while the addition of mica may mark a transition to mica schist. The graphite forms thin flakes or scales disseminated through the rock. In quantity it ranges from a fraction of 1 per cent up to 15 per cent, the usual run being less than 5 per cent. The successful exploitation of the deposits depends upon their large size and even tenor. The principal areas of graphitic quartzite and schist occur in Warren, Washington and Essex counties in the vicinity of Lake George and Lake Champlain. They are also known on the opposite side of the Adirondacks in St Lawrence county.

Crystalline limestones, a part of the Algonkian series of metamorphic rocks, are found in numerous places throughout the Adirondack region. They underlie the valleys in long belts and occasionally outcrop on the ridges. They were originally calcareous sediments more or less charged with silica, alumina, magnesia, organic matter, etc., and like the quartzites have received their

crystalline character through metamorphic agencies. The change has been accompanied by the formation of new minerals such as graphite, mica, hornblende, pyroxene, garnet, tourmalin and titanite, the constituents of which have been derived from the limestone and its impurities. The graphite occurs in flake form with rounded or hexagonal contours. It seldom forms more than 5 per cent of the mass and usually less. In appearance it is bright and clean. Though low grade, the limestones offer an attractive field for exploration. They are very extensive, quite regular in their tenor, and can be treated at a smaller cost than the quartzite owing to their friable nature. The fact that they nearly always contain more or less mica is the only serious drawback to the separation of the graphite.

Present developments. The American Graphite Co., a branch of the Joseph Dixon Crucible Co., has operated for many years at Graphite, in the town of Hague, Warren co. The deposit consists of gray quartzite with graphite flakes distributed along the cleavage planes. It is associated with garnetiferous gneiss carrying sillimanite. The quartzite beds are inclined at a low angle and vary in thickness from 1 to 15 feet or more. The average quantity of graphite present is probably about 8 or 10 per cent. In the concentration plant at Graphite the rock is crushed and concentrated to an average of about 70 per cent graphite. The concentrates undergo further treatment in a refinery at Ticonderoga, the end products being high grade flake graphite and residue. The flake is used mostly as lubricant, while the residue is mixed with imported graphite and made into crucibles.

At Rock pond in the town of Ticonderoga, Essex co., the Columbia Graphite Co. has been actively engaged in exploiting a deposit. The latter resembles the mine at Graphite in that it consists of gray quartzite associated with sillimanite gneiss, but it is not so rich and the graphite occurs in smaller flakes. The quartzite beds are inclined at an angle of 70°. There is a good deal of pyrite and some pyrrhotite in the rock and mica is also present. The company has erected a mill at Rock pond with a daily capacity of 3000 pounds of graphite. The product is hauled by wagon to Ticonderoga for shipment.

In the vicinity of Rock pond other quartzite areas have been found. A very extensive deposit occurs on property owned by John D. Bly who is preparing to develop it.

The Crown Point Graphite Co. has opened a bed of graphitic limestone in the western part of the town of Crown Point, Essex co.

It is intended to separate the graphite by dry crushing and passing the product over screens. A mill is now in course of construction.

Some prospect work has been done on a bed of graphitic limestone situated on the Welch farm, 3 miles southwest of Mineville, Essex co. The bed outcrops along the crest of a low hill and is accompanied by pyritous gneisses which are also more or less graphitic. In one pit a very rich band of limestone has been found, giving assays as high as 15 per cent graphite. The flakes are large and are built up of many laminae into comparatively thick plates. There is little mica in the rock, the accompanying minerals comprising pyroxene, serpentine, pyrite, tourmalin and quartz. The mining rights on the property are owned by the firm of Witherbee, Sherman & Co. of Mineville.

The property of the Champlain Graphite Co. is located 5 miles west of Whitehall in the town of Dresden, Washington co. The deposit outcrops on the western shore and near the head of South bay. It shows considerable variation from the graphitic quartzites mentioned above, though it probably belongs to the same series of metamorphosed sediments. The rock is a thinly laminated graphitic schist carrying quartz, garnet, chlorite and pyrite. An appearance of banding is shown in some specimens due to the distribution of the quartz in seams parallel to the bedding planes. The latter are broken by cross joints and the whole deposit has been squeezed and crumpled by dynamic agencies. The graphite, which is said to constitute from 4 to 9 per cent of the rock, has been drawn out into thin flakes that interleave the other components. The surface of the flakes is polished and frequently striated. Quarry methods are employed in exploiting the deposit. The present workings are near the base of the high ridge which rises close to the western shore of South bay. A face 150 feet across has been explored. The mill which was constructed in 1905 lies about 300 feet from the quarry with which it is connected by a short tramway. Productive operations have only recently been commenced.

The Adirondack Mining & Milling Co. owns a deposit situated a mile north of the one just described. The rock is graphitic schist, almost as fissile as slate. The strata are regularly bedded and dip eastward at a high angle. The graphite forms very fine thin scales coating the cleavage planes. It is accompanied by brown mica, garnet, quartz and pyrite. A large quarry has been opened near the base of the ridge. The mill which lies close by was operated during a part of the year.

In St Lawrence county graphite is associated with crystalline schists in deposits similar to those on the eastern side of the Adirondacks. The Macomb Graphite Co. has developed a property near Pope Mills, town of Macomb. A mill was erected in 1904, but it was not operated last year, except experimentally. The graphite occurs as fine scales in schist and the deposit is said to be extensive.

Separation of graphite. The separation of graphite when it occurs in disseminated flakes is a matter of considerable difficulty. Crystalline graphite has a specific gravity of about 2.25, which is less than that of the accompanying minerals, though the difference is not so great that concentration by gravity methods can easily be effected. The separation is frequently complicated in the case of the Adirondack deposits by the presence of other scaly minerals, chiefly mica and chlorite. While various processes have been devised and employed at different times by companies operating in this region, those now used are based on the principles of wet concentration, that is, crushing and separation by water. For crushing, both California stamps and rolls are employed. The former seem to be better adapted to the hard quartzite than to the softer schist or limestone. After crushing sufficiently fine to release the graphite from its matrix, the material is washed in stationary buddles. In some mills a shaking table such as is used in the concentration of metallic ores precedes the buddle. The table takes out the coarse particles of the heavy minerals as concentrates, while the slimes and graphite are carried away in the overflow. The middlings from the first buddle are retreated, and the separation is continued until a product assaying 70 to 75 per cent graphite is obtained. The graphite is dried, bolted and subjected to a refining process for removal of the remaining impurities. Pneumatic methods and flotation on water are said to be used in refining, though few details as to actual practice have been made known. In its final preparation for market the graphite is polished and graded into sizes.

Production. The production of crystalline graphite in 1905 amounted to 3,897,616 pounds, valued at $142,948. The output was contributed by three companies, viz American Graphite Co., Columbia Graphite Co. and Adirondack Mining & Milling Co. In the previous year the output aggregated 3,132,927 pounds valued at $119,509. The average price for 1905 was 3.7 cents a pound, against 3.8 cents a pound for 1904. Since the beginning of the present year the Champlain Graphite Co. and the Macomb Graphite Co. have started operations at their mines and mills.

The International Acheson Graphite Co. of Niagara Falls reported a production in 1905 of 4,591,550 pounds of artificial graphite manufactured by the electric furnace. The value of the output was $313,980. The quantity reported for the preceding year was 3,248,000 pounds, valued at $217,790.

GYPSUM

The gypsum quarried in New York is the rock or massive variety. It occurs as interbedded deposits in shales and limestones of Salina age. Seams of selenite, the crystallized variety, sometimes accompany the deposits, but they are so limited as to have little economic value. The rock gypsum usually contains clay, carbonates, silica and other impurities, the presence of which in appreciable quantities is injurious to its use for some purposes. Till recently most of the gypsum obtained in the State was ground and sold as land plaster. It has been found, however, that the better quality of rock can be utilized in manufacturing wall plaster, and several companies have engaged in this industry which now consumes the greater part of the output.

The main gypsum beds outcrop near the southern edge of the area occupied by the Salina strata. The latter extend as a belt, 5 to 25 miles broad, from the Niagara river east to Madison county, and thence with diminishing width to Albany county. They dip generally to the south. The gypsum occurs below the Bertie waterlime which marks the top of the Salina, and above the Syracuse salt beds. The following divisions of the Salina group have been established for New York State, beginning with the highest.

1 Bertie waterlime: argillaceous magnesian limestone, used for the manufacture of natural cement in Erie county

2 Camillus shale: workable gypsum deposits, shale and dolomite

3 Syracuse salt beds: horizon of the rock salt

4 Vernon shale: red, gray and green shales and thin dolomites; carries local small seams of gypsum of no economic value

5 Pittsford shale, with interbedded dolomite

There is little doubt that the workable gypsum beds all occur within the horizon of the Camillus shale. Their eastern limit so far as known is in Madison county, but from here they have been traced by outcrop and borings across the central and western parts of the State almost to Buffalo. They have been encountered in many of the deep salt wells which have been sunk south of the Salina outcrop. In sinking the salt shaft at Livonia, Livingston

co. the beds were penetrated between the depths of 1078 and 1296 feet, with a total thickness of 72 feet. The Lehigh salt shaft at Leroy found 75 feet of gypsum at a depth of 390 feet; and the Retsof shaft in Livingston co. found 47 feet at 613 feet depth.

The gypsum is associated with shales and thin limestones which divide it into layers or beds. When the partings are not too thick the entire deposit may be worked in a single breast. Sometimes one or more layers are too impure to be utilized and in underground operations may be left as a foot or hanging wall.

When first extracted the gypsum is gray or drab in color, becoming lighter on exposure with the evaporation of the absorbed moisture. Organic matter is usually the principal coloring agent. Its influence is not particularly detrimental, for it is removed by burning. The presence of iron in any quantity gives a brownish or reddish appearance to the rock which is accentuated in the calcined product.

Productive operations in New York are limited to localities on or near the outcropping deposits. The gypsum beds are often concealed by glacial drift, whence the workings are frequently located along the face of hills where the overburden is lightest. In the eastern section open cut or quarry methods prevail. When the beds have been followed back into the hill for some distance, if the overlying strata are heavy the work may be continued under cover. Mining is carried on at a few places through adit openings or vertical shafts. With this method the workings require support which is obtained by timbering, by storing the waste rock, or by leaving pillars at intervals varying with the condition of the roof. Underground tramways are frequently used in the mines for transporting the rock.

With the immense resources of crude material found within the State, the development of the gypsum industry is dependent altogether upon the demand for the different products. For a long time the principal market outlet was the land plaster trade, as the gypsum was considered of little or no value for plaster of paris, owing to its dark color. The employment of gypsum, however, for the manufacture of wall plaster, stucco and other building purposes has become widespread of late years, and a number of plants making these products have been established in New York State. This branch of the industry now consumes the larger part of the

crude material and its requirements are constantly increasing. The consumption of land plaster, on the other hand, remains comparatively steady from year to year.

Present developments. In Madison county there are quarries near Cotton and Hobokenville. The quarry at Cotton is owned by R. D. Button. The output from this section is small, supplying a local demand for land plaster.

Onondaga county produces a large quantity of gypsum from a number of quarries. The most important are situated about 2 miles southwest of Fayetteville in the town of Dewitt. They are owned by the National Wall Plaster Co., Adamant Wall Plaster Co., F. M. Severance and C. H. Snooks. A new quarry has been opened in the same vicinity by H. H. Lansing. The gypsum has a maximum thickness of 60 feet, separated into several layers of different quality. It carries from 10 to 20 per cent of impurities in the form of lime and magnesian carbonates and clay. The output is used partly for land plaster, but the greater quantity is calcined by the local cement companies or by the wall plaster works in Syracuse. A portion of the calcined product is sold to Portland cement manufacturers. E. B. Alvord & Co. operate a quarry at Jamesville. There are properties also at Manlius Center, Marcellus and Halfway that are intermittently active.

The Cayuga Plaster Co. at Union Springs, Cayuga co. is one of the leading producers of land plaster.

In Ontario county there are two producers of land plaster, Ezra Grinnell of Victor and Theodore Conover of Port Gibson.

Operations in Monroe county are confined to the town of Wheatland, southwest of Rochester. The Lycoming Calcining Co. and the Garbutt Gypsum Co. have properties at Garbutt. There are three beds of gypsum about 6 feet apart, the upper being the one most worked. The bed is reached by adits and the workings are entirely underground. The Consolidated Wheatland Plaster Co. is engaged in exploiting a mine 3½ miles east of Caledonia. The deposit here is about 6 feet thick. This company makes a large quantity of agricultural plaster, as well as plaster of paris, while the others calcine the principal part of their output. Prospecting for new mines was quite active in this section during the past year. It is reported that options on several properties have been secured by the Pittsburg Plate Glass Co. and that plans have been formulated by the company for the erection of a mill. The Monarch Plaster Co. was incorporated for the purpose of mining gypsum in

the vicinity of Wheatland. It has already opened a deposit said to be from 6 to 8 feet thick and of excellent quality. The company contemplates installing a mill during the present season.

In Genesee county the list of producers comprises the United States Gypsum Co. and the Oakfield Plaster Co. The former operates two mills, one at Oakfield Station and the other about 2 miles west on the line of the West Shore railroad. The gypsum occurs at a depth of 40 feet, the thickness being 4 feet. It is hoisted in vertical shafts and conveyed to the mills by a steam tramway. The Oakfield Plaster Co. owns mines 2½ miles west of Oakfield Station. Both companies make wall plaster and plaster of paris.

In Erie county small quantities of gypsum have been produced from deposits near Akron. The output is consumed locally for agricultural purposes. The Akron Gypsum Co. has been engaged recently in developing a mine at that place.

Production of gypsum. During the past year there were 15 companies and individuals engaged in the production of crude gypsum, the output of which amounted to 191,860 short tons. In 1904 the output was 151,455 short tons reported by 16 companies, showing a gain of 40,405 tons for the year. The greater part of the output in both years was converted into wall plaster and plaster of paris, the combined product amounting to 130,268 tons valued at $478,847 in 1905 and 88,255 tons valued at $347,885 in the preceding year. The quantity sold as land plaster was 19,815 tons valued at $39,014, against 33,712 tons valued at $62,438 in 1904. A further portion amounting to 27,980 tons valued at $34,095 in 1905, and to 9768 tons valued at $14,652 in 1904, was sold in the crude state.

Production of gypsum

	1904		1905	
	Short tons	Value	Short tons	Value
Total output	151 455	$424 975	191 860	$551 193
Sold crude	9 768	14 652	27 980	34 095
Ground for land plaster	33 712	62 438	19 815	39 014
Wall plaster etc. made	88 255	347 885	130 268	478 084

Bibliography

Luther, D. D. Economic Geology of Onondaga county. N. Y. State Mus. 49th An. Rep't. 1898. v.2.

Merrill, F. J. H. Salt and Gypsum Industries of New York. N. Y. State Mus. Bul. 11. 1893.

Parsons, A. L. Recent Developments in the Gypsum Industry of New York State. N. Y. State Geol. 20th An. Rep't. 1902.

—— Notes on the Gypsum Industry of New York. N. Y. State Geol. 23d An. Rep't. 1904.

IRON ORE

Iron ores constitute the most valuable of the metallic minerals found in the State. At one time they were very actively exploited, and New York contributed a large portion of the ore consumed in this country. The decline in relative importance which began about 25 years ago has been primarily due to the great changes that have taken place in the mining and metallurgical industries, of which the most influential are the development of new districts better situated for production and transportation, the gradual extinction of the charcoal bloomery for making the finer grades of iron and steel and the substitution of cheaper processes employing coke as fuel. It is generally recognized, however, that the depression is only temporary. With the rapidly growing consumption of iron and steel additional ore supplies are needed, and it seems inevitable that mining operations must be extended beyond their present fields.

During the past year or two there has been a noticeable improvement in the mining industry of the State. This applies not only to the larger output from established mines, but to the increased interest shown in prospecting and development enterprises.

Production

The production of iron ore for the period 1890-1905 inclusive is given in the following table. The statistics covering the years previous to 1904 are taken from the annual volumes of the *Mineral Resources* published by the United States Geological Survey.

The condition of the mining industry during 1905 was very satisfactory. The total shipments reported by the mines of the State amounted to 827,049 long tons, valued at $2,192,689. Compared with the previous year there was a gain in shipments of 207,946 tons or about 34 per cent. The output was the largest since 1892.

Classified as to variety the production consisted of 739,736 tons of magnetite, 79,313 tons of hematite and 8000 tons of limonite. Of the magnetite 432,867 tons were marketed in the form of con-

centrates carrying approximately 65 per cent iron. The 306,869 tons of lump magnetite averaged about 60 per cent. The hematite and limonite may be estimated at about 45 per cent iron.

The magnetite concentrates were made from 715,203 tons of crude ore. Using that figure as a basis for calculation, the total quantity of ore hoisted from New York mines in 1905 was 1,109,385 long tons.

The magnetite was derived from the Adirondacks, none of the mines in southeastern New York being active. The producers included Witherbee, Sherman & Co. and the Port Henry Iron Ore Co.,

Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	Total value	Value per ton
	Long tons	Long tons	Long tons	Long tons	Long tons		
1890	945 071	196 035	30 968	81 319	1 253 393	.....	.....
1891	782 729	153 723	53 152	27 612	1 017 216	.....	.....
1892	648 564	124 800	53 694	64 041	891 099	$2 379 267	$2 67
1893	440 693	15 890	35 592	41 947	534 122	1 222 934	2 29
1894	.....	.....	.....	.....	242 759	.....	.....
1895	260 139	6 769	26 462	13 886	307 256	598 313	1 95
1896	346 015	10 789	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 999	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 985	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	329 467	66 389	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 899	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 804	2 15
1905	739 736	79 313	8 000	Nil	827 049	2 192 689	2 65

at Mineville; the Arnold Mining Co., at Arnold, and the Delaware & Hudson Co., at Lyon Mountain. In addition the Salisbury Steel & Iron Co. made a small output in connection with the development of their mine at Salisbury.

The hematite came from two mines in St Lawrence county operated by the Old Sterling Iron Co. and the Rossie Iron Ore Co., and from two mines in the Clinton formation worked by C. A. Borst and the Furnaceville Iron Co. The single producer of limonite was the Amenia Mining Co., in Dutchess county.

The Saranac Iron Mining Co. was engaged during the year in prospecting for ore in the Adirondack region. It is reported that plans have been considered for reopening the Benson mines in St Lawrence county. The Fair Haven Iron Co. has been incorporated recently for the purpose of mining ore at Fair Haven, Cayuga co.

Occurrence

Deposits of iron ores are abundantly distributed, and it is impracticable here to give more than a few of the principal facts relating to the occurrence. They are, naturally, grouped into more or less definite areas or regions determined by geologic and geographic boundaries. Nearly all the workable deposits occur in the following areas.

1 Adirondack region. Magnetite ores with occasional hematite (martite), in Precambric gneisses. Also titaniferous magnetite in basic igneous rocks of the gabbro family that are intrusive in the gneisses.

2 Highlands of the Hudson. Magnetite in Precambric gneisses.

3 St Lawrence and Jefferson counties. Hematite associated with crystalline limestone, serpentine and schist of Precambric (Grenville) age.

4 Central and western New York. Fossil and oolitic hematite interbedded with limestones and shales of the Clinton group.

5 Dutchess and Columbia counties. Limonite associated with crystalline limestones, slates and schists, representing metamorphosed Cambro-Siluric strata. Siderite, the carbonate of iron, sometimes accompanies the limonite and in one group of mines it is the principal ore.

6 Staten Island. Bog ore (limonite) occurring in superficial deposits resting on serpentine.

1 The nontitaniferous magnetities of the Adirondacks are found on the outer borders in Washington, Warren, Essex, Clinton, Franklin and St Lawrence counties. On the southern side they are less prominent; the Salisbury mines in Herkimer county, however, belong to this type. The country rock is chiefly gneiss, with bands of crystalline limestone, quartzite and schists that are undoubted sediments. The gneiss shows great variation from place to place, but in the vicinity of the ore bodies it is prevailingly a rather acid rock of ligh color, composed of alkali feldspar, quartz and one or more dark silicates, most commonly augite and hornblende. Its mineralogy is that of granite or syenite. Though the great mass is of uncertain origin, some phases of the gneiss have an igneous character. A quartz-plagioclase gneiss and basic hornblende gneisses are found over limited areas. The ore bodies lie along or near the contact of two varieties of gneiss, or of gneiss and gabbro, and again are apparently in the interior of a gneiss belt. They conform closely in dip and strike to the lamination

of the wall rock. In the northern districts of Clinton and Franklin counties they take the form of sheets and elongated lenses inclined at a high angle, and with some exceptions are quite free from irregularities due to folding or other dynamic influences. Conspicuous examples are the great ore zone at Lyon Mountain extending several miles along the strike, the similar but smaller deposits of Palmer hill and the succession of lenticular bodies of Arnold hill. The magnetite may occur as disseminated particles associated with the minerals of the gneiss, as at the first mentioned locality, constituting a lean ore which requires concentration before it can be used commercially. Again there are deposits of nearly pure magnetite. The lean ores as a rule contain less apatite and thus have some advantage over the rich but phosphoric ores.

In the southeastern Adirondacks there are a great number of magnetite deposits of varying size and character. While the prevailing type is lenticular the form has been greatly modified by the extensive faulting and folding that have taken place. This is particularly true of the Mineville and Hammondville districts in Essex county where the ore bodies exhibit great irregularities. At Mineville occur some of the largest deposits of high grade magnetite in the country.

On the northwestern side of the Adirondacks magnetite ores are not so widely distributed. The Benson, Jayville and Clifton deposits in St Lawrence county, however, are known to be extensive. At Benson the ore contains much quartz and feldspar and resembles the disseminated magnetites of Clinton county.

The titaniferous magnetite deposits are distinguished from those just described by their association with clearly igneous rocks of basic composition. They undoubtedly represent segregations from the surrounding rock mass while it was in a fused condition. Every gradation from normal rock to pure magnetite can be found. The deposits are developed in western Essex county at Lake Sanford and in the towns of Elizabethtown and Westport, not far from Lake Champlain.

2 The Precambric gneisses which enter the southeastern part of the State from New Jersey forming the ridges known as the Highlands of the Hudson, contain magnetite deposits somewhat similar to those in the Adirondacks. About 40 mines have been operated in the region in Orange, Putnam, Rockland and Westchester counties. The ore bodies have a northeasterly trend, conforming to the gneiss, and usually show a pitch across the dip. They vary in shape from lenticular masses to thin sheets, while some are very irregular.

The ores are crystalline magnetites, rich and free from titanium, but generally containing too much phosphorus to pass as Bessemer grade. Mining has been carried on intermittently for 150 years. The Sterling mine near Warwick and the Forest of Dean mine near Fort Montgomery are among the more important mines in Orange county. They have been inactive for several years. The Tilly Foster and Mahopac mines of Putnam county have yielded Bessemer ores. The former was of unusual size, the ore body measuring 1500 feet long and 160 feet wide at the middle.

3 This district is confined to a narrow belt running northeasterly from Philadelphia, Jefferson co., to Rossie, St Lawrence co., a distance of 30 miles. In this section the Adirondack gneisses and crystalline limestones continue as far as the St Lawrence river, though there are intervals where they are concealed by the Paleozoic formations. The hematite deposits lie below the Potsdam and are associated with an altered rock locally called serpentine. C. H. Smyth jr,[1] who has described very fully the relations of the ore bodies, has explained the serpentine as a product of alteration of the surrounding granite and gneisses. The ore bodies are irregular and inclose knobs and masses of the wall rock which sometimes cut off the ore entirely. They appear to occupy an approximately definite horizon in the gneiss series parallel to a stratum of pyritous schist. The ore is an earthy massive hematite of deep red color. Cellular and stalactitic varieties occur, and in some deposits there is much specular ore. It runs from 40 to 50 per cent iron with phosphorus in excess of the Bessemer allowance. The Old Sterling mine, near Antwerp, and the Caledonia and Kearney mines near Spragueville have been very productive.

4 The Clinton formation outcrops as a narrow but persistent band extending over 200 miles from the Niagara river east to Herkimer county. It is composed mainly of green shales and limestones with one or more beds of hematite. The latter does not appear in the extreme western section, being first encountered in Monroe county. At the Rochester gorge of the Genesee river there is a single bed 14 inches thick, underlain by 23 feet of green shale. The overlying beds include 14 feet of limestone, 24 feet of green shale and 18 feet of limestone at the top. At Ontario, Wayne co., the ore is found beneath 20 feet of shale and earth and has a thickness of 22 inches. The existence of more than one bed at this point has not been established. Farther east in Cayuga county near Sterling two beds, aggregating 36 inches, have been mined. Recent explora-

[1] N. Y. State Mus. 47th An. Rep't. 1894. p. 687.

tion in this vicinity has indicated a thickening of the ore to over 4 feet in places. At Clinton, Oneida co., the type locality, three beds occur of which only the middle one has been exploited. The highest from 4 to 6 feet thick is composed of pebbles and fossil fragments coated with ferric oxid and cemented by calcite. It is locally called red flux. The workable ore 2 feet thick lies 25 feet below this and is separated by 2 feet of rock from the third bed which is about 8 inches thick. The extension of the Clinton ore to the east has been followed as far as Frankfort, Herkimer co., and Salt Springville, Otsego co.

The hematite has a deep reddish color. It is solid and firm when mined underground, but soft and friable in weathered outcrops. It consists mostly of oolitic grains or concretions which have apparently been deposited in rather shallow water. The grains often inclose a kernel of quartz sand as a nucleus. The ore averages high in phosphorus, but is well adapted for foundry iron. It assays about 45 per cent. A considerable quantity of the ore is ground for paint.

5 The limonite deposits of Dutchess and Columbia counties are a part of the great series of similar deposits that extend from Vermont through Massachusetts, Connecticut, New York and south to Alabama along the Appalachian uplift. There are two principal ranges within the State: the one running northeast from Fishkill in the valley of Fishkill creek, Dutchess co., and the other farther east following the north and south valley, traversed by the Harlem railroad, from the Highlands in Dutchess co. to Hillsdale, Columbia co. The latter is the more important. The geologic formations comprise Precambric gneisses and stratified quartzites, limestones and schists. The quartzites lie immediately on the gneiss and have been assigned to the Lower Cambric. The limestones and schists are probably of Cambro-Ordovicic age.

According to Smock the ore bodies are found in the limestone, or between the limestone and the adjacent schist, or they lie within the latter; as a rule they favor the contact of these formations. The limonite forms small irregular pockets as well as large deposits, and is associated with ochreous clay. Some carbonate ore is found in the deeper workings, where it is interstratified with the limestone. Its occurrence strongly suggests that the limonite has been formed by oxidation and hydration of deposits of this ore. About 25 mines have been worked at different times. They are mostly open pits, but occasionally drifts are run from the bottoms of the pits following the course of the ore body. The product is divided into

"rock ore," that which is sorted by hand, and "wash ore," the residue obtained after removing the clay and sand by washing. It carries from 40 to 50 per cent iron and less than 1 per cent phosphorus. Among the prominent mines that have been active within recent years may be mentioned the Sylvan lake group, the Beekman, Pawling, Clove and Dover mines in Dutchess county and the Manhattan, Weed and Copake mines in Columbia county. The Amenia mine at Amenia, Dutchess co. is the only one now operated.

In the western part of Columbia county, a short distance from the Hudson river, there is a small district that has produced carbonate ores. The ore bodies lie along the western slope of a range of hills at an elevation of 300 or 400 feet above the river. They are included between slates and sandstones of the Hudson river series and show many points of similarity to the limonite deposits above described. The Burden mines are the largest in the district. They were worked between the years 1875 and 1901. The ore is a gray compact siderite containing some calcite, quartz and pyrite. Though low grade, the average tenor can be raised by roasting to about 50 per cent iron. The greater part of the ore is of Bessemer quality.

6 Limonite ores occur within the serpentine area of Staten Island and at one time were quite extensively mined. The serpentine underlies the broad ridge extending from St George on the north shore to Richmond near the center of the island. It is undoubtedly a metamorphosed basic intrusive allied to the peridotite class of rocks. The ore lies in superficial depressions directly upon the serpentine and is generally covered by glacial drift. It carries from 38 to 55 per cent iron. A small percentage of chromium is shown in the published analyses; its presence may be ascribed to leaching of the serpentine which contains chromite and is probably also the source of the iron. The principal openings are the New Dorp, Tower, Cooper & Hewitt and Tyson mines.

Notes on mining developments

Mineville. This well known district holds the leading place among the producers of iron ore in the State. The deposits are of unusual size, affording the basis for large scale operations with their consequent economies, and are also above the average in richness. They are worked by Witherbee, Sherman & Co. and the Port Henry Iron Ore Co.

The mines now active comprise "21," Bonanza and Joker of the Old Bed group and the Harmony and Smith mines. Mine "21"

belonging to the Port Henry company, with the Bonanza and Joker of Witherbee, Sherman & Co., are on a single ore body which for some time has supplied the greater part of the output from the district. There are reserves sufficient to last for many years. The continuation of the ore body in depth beyond the present workings has been proved by diamond drilling. Developments in the Joker mine during the past year have also enlarged its limits along the line of strike. At the south end of this mine the deposit is cut off by a diabase dike which it was thought might mark a line of faulting; drill holes driven through the dike have found ore for indefinite distances, so that little, if any displacement seems to have occurred.

The Harmony mine lying south of the Joker shaft was opened quite recently by Witherbee, Sherman & Co. and is still under development, though supplying important quantities of ore. It is equipped with two large shafts. The Smith mine belonging to the same company is located some distance north of the Old Bed group. It was inoperative for several years and is now being reopened.

The Mineville ores are varied in character. Those from the Old Bed are the richest in iron and carry the largest amount of phosphorus. They are particularly adapted for making basic iron, owing to their low silica content combined with high phosphorus. The latter usually exceeds 1 per cent, but can be reduced nearly one half by concentration. They are also extensively employed as a basis for mixtures with other ores in making foundry irons. The Harmony mine yields an ore containing less phosphorus, though not within the Bessemer limit. The New Bed and Barton Hill workings, which are now closed down, have supplied excellent Bessemer ores.

Both companies have well equipped surface plants for handling the mine output. The installation of Witherbee, Sherman & Co. is specially extensive and includes two large mills for crushing and concentrating the ore from their different mines. Concentration is effected by magnetic separators of the Ball & Norton drum and endless belt types.

In treating the Old Bed ore the iron content is raised from about 60 per cent to over 65 per cent and the phosphorus lowered to .5 or .6 per cent. The tailings from these separators are retreated by Wetherill machines which make a further concentrate of magnetite and a tailings product carrying 12 per cent phosphorus, or

60 per cent tricalcium phosphate, which is sold to fertilizer manufacturers. The low grade ores from the Harmony and Smith mines are also concentrated.

At B shaft on the Harmony a mechanical cobbing apparatus is under course of construction, which will facilitate the separation of the furnace and concentrating ores. After hoisting, the ore is fed into a large size Blake crusher and is then carried by a conveyor belt to a double drum magnetic separator, where the magnetite is removed for direct shipment. The mixed ore and rock goes to the mill for additional treatment.

Electric power is employed in the mills as well as for hoisting and pumping at the mines. Most of the current required is supplied from the central power station erected by Witherbee, Sherman & Co. in 1902. The generator is of alternating type, 750 kw. capacity, directly connected to a 1000 h.p. Nordberg-Corliss engine. A second power house is equipped with a 150 kw. generator, besides hoisting and compressor apparatus. The mines are also connected with the electric generating station at Wadhams Mills on the Bouquet river and with a new plant on the Black river erected during the past year.

The Port Henry Iron Ore Co. has maintained steady operations in mine "21." A good deal of ore was taken from the bottom of the open pit near the incline by blasting out the irregularities of the floor and walls. Late in the year a vertical shaft was started between mine "21" and mine "23," on the hanging side of the latter, and encountered ore within a few feet of the surface. Some exploration has been done on a property located between the Old Bed and Harmony mines.

The year 1905 was the most active one in the history of the district. The quantity of ore hoisted by the two companies exceeded 650,000 tons. About 600,000 tons of lump ore and concentrates were shipped, all of which was high grade magnetite carrying over 60 per cent iron. With the progressive policy of the companies in extending mining operations and improving their installations, a still larger output may be anticipated for the immediate future.

Lyon Mountain. The mines at Lyon Mountain, on the Chateaugay branch of the Delaware & Hudson railroad, were operated steadily throughout the year. Extensive improvements in both surface and mining plants have been undertaken, the most important being the construction of a new mill which was begun early in the fall. Additional facilities for mining and handling the ore have been necessary to provide for the enlarged milling capacity.

The Lyon Mountain ore bodies are low grade but of unusual size. They may be described as impregnated zones in the country rock of the region, which is a light colored augite gneiss varying from the composition of granite to that of syenite. The zones are of sheet-like or tabular form and have a northeast-southwest strike in conformity with the gneiss. Their outcrop extends along the northern slopes of the mountain at an elevation of about 2000 feet.

The ore bodies are remarkable for their regularity as well as their continuity along the strike and on the dip. From shaft 16 near the present mill openings have been made at frequent intervals southwest to the Burden mine, a distance of over 3500 feet. In this section, two and in one place three parallel ore bodies have been found. Immediately northeast from slope 16 the deposit has not been worked, though its existence has been established by magnetic observations, while 2500 feet distant from this point is mine 82 where the first ore was mined. The Parkhurst mine, which appears to be on the same ore zone, lies over 2 miles northeast of mine 82.

Throughout most of its extent, the deposit shows little disturbance, the outcrop follows an almost straight line and the walls are smooth and evenly spaced. There is no tendency to the formation of lenticular ore bodies which are common in other districts of the Adirondacks. On the southwestern end, however, the strike changes rather abruptly to east and west, due to a fold, while the dip swings around from northwest to north and becomes considerably flatter. This change is accompanied by crumpling and minor folding in the deposit. Between shaft 5, which approximately marks the axis of the fold, and the Burden mine, the bounds of the deposit are not well defined; the outcrop, however, shows a marked widening in this part.

Beyond the Burden mine the geologic structure is obscured by the heavy drift deposits which cover the adjoining valley. The extent of the deposit in this direction has not been definitely determined. It is known that one or more ore bodies occur on a low hill to the west, parallel to the main group, but their relation to the latter is problematic. It seems improbable that the deposit should terminate abruptly, except by faulting, and in this case its continuation may be represented by the ore bodies just mentioned.

The ore consists of a granular mixture of magnetite with feldspar, quartz, hornblende and augite. Mineralogically it resembles the gneiss wall rock, though of course much richer in magnetite. The average material as mined carries probably 50 or 60 per cent of this mineral, corresponding to 30 or 40 per cent iron. As a rule the

magnetite is finely divided, having the form of lenticular and irregular granules that may be distributed evenly throughout the rock mass, but are more commonly grouped into parallel bands which alternate with the other constituents. It occurs not infrequently in considerable bodies and then has a much coarser texture. Feldspar, which is next in importance to magnetite, is represented by orthoclase, microcline and oligoclase, the latter being white while the others are of reddish color.

Pegmatite frequently accompanies the ore bodies and sometimes carries enough magnetite to be commercially valuable. So far as observed it rarely, if ever, takes the form of dikes with well defined walls. Its composition usually is similar to that of the gneiss, but it somtimes contains secondary minerals like scapolite and epidote that replace the feldspar.

Mining operations at present, and for some time past, have been confined to the southwestern section between shaft 16 and the Burden mine. The workings are very extensive and include about 20 inclined shafts or slopes driven on the dip of the ore. Most of the shafts are driven on the front or main "vein" which has been chiefly exploited. Among those recently operated are, in order from north to south, nos. 14, 12, 7, 5, 4, 3, and the Hall shaft. The deepest are no. 4 which is down 1600 feet, or 800 feet vertically, and no. 3 and the Hall, nearly to the same level.

The thickness of the ore body on the front vein, as shown near the surface, averages about 20 feet. The workings which extend along the strike widen, however, in depth, so that on the bottom level of the Hall slope there is a breast of ore measuring over 200 feet from wall to wall. This widening is due in part at least to the change of dip which decreases with depth. It has been suggested, also, that the three parallel ore bodies, separated at the surface by many feet of wall rock, may unite below, but there is little reason for believing this to be the case.

The only portion of the back "vein" that has been worked to any extent is at the extreme southwest on the east-west wing of the fold. The main openings are the Weed, Cannon and Burden. The shafts are now dismantled, and ore is mined by open cutting along the outcrop. The Burden and Cannon open cuts have recently supplied a large output. The ore is broken down by drilling and blasting and hoisted to the surface by derricks. As a result of these excavations, a much greater width of ore has been uncovered than had been supposed to exist from the nature of the underground workings.

The entire production of the mines is marketed in the form of concentrates. Formerly the richer material was sorted out and shipped separately, but this practice has been discontinued. The quantity of crude ore treated daily is about 1000 tons. From two and a half to three tons are required to make one ton of concentrates.

In its metallurgical character the Lyon Mountain ore is unique compared with the product of other mines in the Adirondacks. It is all well below the Bessemer limit carrying a remarkably small percentage of phosphorus. The sulfur content is likewise low. The following analyses recently made by Mr James Brakes, chemist for the mining company, give complete details as to the composition of the ore:

	1	2
Ferric oxid (Fe_2O_3)	31.48	60.128
Ferrous oxid (FeO)	15.81	28.850
Silica (SiO_2)	33.16	6.880
Titanic oxid (TiO_2)	.427	.417
Sulfur (S)	.027	.022
Phosphoric acid (P_2O_5)	.043	.023
Alumina (Al_2O_3)	4.90	.900
Ferrous oxid (gangue) (FeO)	2.83	.257
Manganous oxid (MnO)	.115	.107
Lime (CaO)	4.96	.660
Magnesia (MgO)	2.10	.405
Potash (K_2O)	1.438	.494
Soda (Na_2O)	2.283	.777
Moisture (H_2O)	.25	.040
	99.823	99.960
Total iron	36.50	64.72
Iron in magnetite	34.30	64.53
Phosphorus	.019	.010
Titanium	.256	.250
Manganese	.089	.083

Analysis no. 1 represents the crude ore and no. 2 the concentrates. Both are made from average samples taken in the usual course of operations. While the concentrates in the above analysis contain .010 per cent phosphorus, this represents about the maximum limit for the mine. The percentage of sulfur fluctuates from about

.019 to .022. The small amount of titanium present is interesting, though it has no effect upon the metallurgical value of the ore. It is due to the occurrence of small titanite crystals in the gangue.

While the magnetite is distributed in grains through the matrix, it is readily released on crushing. The usual practice is to pass the ore through coarse crushers and then through a succession of rolls adjusted to give a final product of ¼ inch size.

The new mill will have a capacity of 50 tons crude ore per hour. The methods to be used are based on those employed in the old mill and at Mineville, with few modifications. The mill will be divided into three sections, each operated independently so as to avoid a general shut-down in case of accident. The first section is the crushing section and is to be supplied with Blake and Gates crushers and coarse rolls. After being broken to 1 inch size the ore passes into a storage bin for the second section which will comprise four sets of rolls giving an end product of ¼ inch size. The third or separating section will have eight Ball & Norton double drum separators and four sets of rolls for regrinding middlings and tailings. The final products will be carried by conveyor belts to the loading bins with a capacity of 1000 tons. The tailings have been used for concrete and other purposes with such success that an increased market for them is anticipated. For the manufacture of concrete blocks they are especially well adapted. They are extensively shipped for this purpose to points as far distant as Scranton, Pa.

The site of the new mill is centrally located with respect to the mines now operated and possesses an additional advantage over the old location of being at a considerably lower elevation, thereby facilitating transportation from the different shafts.

The concentrates from Lyon Mountain are used in making low phosphorus iron. They are shipped in part to Pennsylvania furnaces and the remainder is smelted at Port Henry and Standish. At the latter place a new 200 ton furnace has been erected on the site formerly occupied by a charcoal plant and was blown in late ing 1905. The furnace is operated by the firm of Pilling & Crane under lease from the Delaware & Hudson Co.

Mine 81. This mine is situated 4 miles southwest of Lyon Mountain and 1 mile from Standish. It is a part of the properties formerly owned by the Chateaugay Ore & Iron Co., now in the hands of the Delaware & Hudson Co. The mine has not been operated within the last year. The deposit lies on the western slope of a low hill and has a northeast-southwest strike which brings it about in line with the main ore zone of Lyon Mountain. The dip is 80° south-

east. There are two shafts 400 feet apart, reaching a depth of something over 100 feet. In the open cut along the outcrop a good exposure is afforded of both the ore body and the inclosing walls. The distance between the latter averages about 15 feet, but increases in places to 20 to 25 feet. The wall rock is a massive gneiss of the same general character as that at Lyon Mountain; it contains, however, a good deal of hornblende in addition to augite and is quite pegmatitic in places.

The ore is usually a coarsely crystalline aggregate of magnetite, augite, hornblende and feldspar. It is practically all of concentrating character. An analysis of the crude material (1) and the concentrates (2) quoted by Putnam, shows the following composition:

	1	2
Iron	34.81	65.14
Phosphorus	0.041	0.017

No determination of sulfur is given. The output of the mine was concentrated at Standish and used in the furnaces there and in the Saranac valley.

Arnold hill. The Arnold hill mines have been operated for a longer period, probably, than any other magnetite mines in the Adirondack region. According to local records the first discovery of ore was made about 1806. Exploitation began shortly after that date for the supply of forges in the Ausable valley. Up to 1864 the output, which was obtained mostly from open cast workings, amounted to a total of 164,000 tons. The change to underground mining more recently has broadened the scope of operations and has shown the existence of an ore supply sufficient to last for many years. The mines are now worked under lease by the Arnold Mining Co.

The deposits lie along the southern and eastern slope of Arnold hill, about a mile west from Arnold station on the Ausable branch of the Delaware & Hudson railroad. They form a nearly parallel series extending n. 20° east. Beginning at the south end the first is the Finch mine, now abandoned and filled with water, and the Wells and Indian mines which were mainly worked in the early days as open cuts. The Arnold or Big mine is about ¼ mile north of the latter; it has yielded a large output, but owing to the loss of the shaft by caving, it has lain idle for the past 10 or 12 years. The Nelson Bush or Barton mine, 1500 feet north of the Arnold, is the only one of the group now under exploitation.

The ore bodies are tabular in form, though showing at times rather marked modifications. The walls pinch and swell along the strike and on the dip, and when the irregularities become pronounced the ore bodies assume the shape of lenticular masses arranged in successive order. The narrowing of the walls seldom cuts off the ore entirely between the lenses. The dip is northwest at a high angle.

An interesting geologic feature in connection with the deposits is the existence of frequent displacements which were first noted and commented upon by Emmons. So far as observed the faulting always takes place across the strike, producing a lateral offset in the line of outcrop. The displacements are small, usually not more than 20 feet, and do not seriously affect operations. At the Sucker mine a thin diabase dike has been intruded along the plane of such a fault.

The Nelson Bush mine is opened by two shafts 500 feet apart, apparently on the same outcrop, although not connected underground. Both shafts are driven on an angle along the course of the deposit. The northern shaft is down 900 feet on the incline which varies from 60° to 30°, while the southern is down 300 feet with an angle of from 42° to 35°. The ore body ranges from 10 to 25 feet thick, the maximum being reached at the north end. As a rule the walls are formed of a reddish augite gneiss that has the mineralogic composition of syenite. Near the ore, however, there is much darker gneiss containing hornblende. The latter variety is found to a greater or less extent all through the deposit, usually as bands of variable thickness alternating with the magnetite.

Although the entire mine output at present is concentrated, a fair proportion contains sufficient iron to be classed as furnace ore. Yet concentration exercises a beneficial influence upon the quality of the product, specially as it reduces the phosphorus content. In some of the richer material apatite shows very prominently. In the concentrating ore the magnetite occurs in aggregates rather than as disseminated particles, so that coarse crushing serves to release most of it. On the average a little less than 2 tons of crude ore is required to produce 1 ton of concentrates carrying 65 per cent iron.

The Arnold mine adjoins the Nelson Bush on the south. It has been a large producer in the past and there is some prospect of its being reopened. The deepest workings are about 800 feet. It is said that the ore bodies narrowed in depth and showed evidences of pinching out, but this point can hardly be regarded as established in view of the little exploration that has been made. It seems

equally probable that the narrowing may be only a temporary feature, inasmuch as the deposits are inclined to be lenticular.

The mine possesses some unique features from a geologic standpoint. Three parallel ore bodies occur known as the black vein, the blue vein and the gray vein, with a maximum distance between the adjoining walls of each of 40 feet. The dip is 70° at the surface flattening to 55° at 325 feet. Smock states that the deposits have a marked shoot structure and pitch at an angle of 40°. The first ore body encountered on the foot wall is the gray vein which is from 3 to 25 feet thick. It yields a granular mixture of magnetite and gangue minerals, chiefly quartz and feldspar. The gangue is stained by iron, and when observed in hand specimens the ore has a mottled gray appearance. In the black vein the ore is a fine, somewhat friable magnetite, carrying rounded grains of apatite and resembles the product of the Nelson Bush mine. In contrast with the other two the blue vein affords martite, a form of hematite pseudomorphous after magnetite. It has a granular to massive texture, steel-blue color and reddish streak. It is seamed more or less with jasper and calcite, but is a rich ore. The conversion of magnetite into hematite, which has evidently taken place here, offers no difficulties of explanation, though it may be said that it is not a common occurrence in Adirondack deposits. It is less apparent, however, why the ore body on the hanging wall should have been affected, while the others under apparently similar surroundings have largely escaped the change.

The Arnold mine has been opened for a distance of about 700 feet along the strike. There are two slopes, 500 feet apart, driven on the dip of the gray vein. Cross cuts connect the levels on this vein with the overlying black and blue veins which were exploited in conjunction with the former.

At the south end the Wells, Finch and Indian mines have not been in operation for many years. The pits are filled with water and debris, and little information can be obtained as to the extent of the ore. There are evidently several parallel deposits of the same general character as those already described.

The present capacity of the mines when under full operation is about 240 tons a day. Compressed air supplied from the large compressor plant at Arnold station is used in operating the hoists as well as in the underground work. The ore is loaded into cars and conveyed over an incline to the separator, at the station, the cars being run in balance.

During the past year the North shaft of the Barton mine has been equipped with a new head frame and shaft house with ore bins, and a number of other additions to the surface plant have been made. An enlarged output may be anticipated in the future operations of the company.

The ore of the Arnold hill mines is non-Bessemer, though the phosphorus is not specially high. Average samples of the rich ore from the Nelson Bush (1) and Arnold mine (2) show the following composition:

	1	2
Ferric oxid (Fe_2O_3)	57.85	83.14
Ferrous oxid (FeO)	27.50	5.27
Silica (SiO_2)	7.62	7.64
Titanic acid (TiO_2)	.39	.26
Sulfur (S)	.038	.035
Phosphoric acid (P_2O_5)	.618	.531
Alumina (Al_2O_3)	1.68	1.72
Manganous oxid (MnO)	.15	.31
Lime (CaO)	2.48	.64
Magnesia (MgO)	1.26	.108
Copper (Cu)	.006	.005
Nickel (Ni)	.072	.003
	99.664	99.662
Total iron	61.90	62.30
Phosphorus	.269	.232

The ore from the Arnold mine represents the "blue vein" which is mostly martite. The small percentage of nickel and copper is noteworthy.

Palmer hill. These mines are 3 miles southwest of the Arnold hill group and 1½ miles north of Ausable Forks. During the period of their activity, from about 1830 to 1890, they supplied a total of over 1,000,000 tons of ore. They were operated by the J. & J. Rogers Iron Co., and the Peru Steel Ore Co., in connection with the forges at Clintonville, Ausable Forks, Black Brook and Jay.

The deposits outcrop near the summit of the hill in a general northeast-southwest direction, though following to some extent the curve of the topographic contours. The elevation is a little over 900 feet.

While the country rock belongs to the same series as that at Arnold hill, being an augite gneiss with occasional hornblende, the

rock adjacent to the ore is much more acid and contains practically no dark silicates. The magnetite is gathered into layers or bands or is distributed as small grains through the rock mass. When the bands coalesce, they may form a body of high grade ore several feet thick. Such rich zones were sought for and exploited in preference to mining the whole breast of the deposit, so that there is little system in the way in which the workings have been laid out.

The principal openings in order from south to north, are known as the Elliot, White Flint, Big pit, Summit, Lundrigan and Little pit. With the exception of the Elliot, which seems to lie at a lower horizon, the shifts are all in the same zone. The total length measured along the outcrop is over 2000 feet. There are also extensive surface workings. The last mining was done in the Elliot slope which is bottomed at 500 feet. It is said that the ore shows a thickness of 9 feet in the lowest level. At the White Flint the outcrop is about 20 feet from wall to wall and the greatest depth reached 1200 feet. The Big pit is separated from the White Flint by a diabase dike which extends north over the summit of the hill. Another dike follows the line of outcrop, cutting vertically across the ore body. The Big pit reaches a depth of 2200 feet on the dip, which begins at 50° and gradually lessens until nearly horizontal.

The principal gangue minerals accompanying the magnetite are quartz and feldspar. According to former practice the material was roasted, crushed by stamps and separated in a crude form of jig. The object of roasting was simply to render the ore friable so as to diminish the labor required for crushing. There is little sulfur present. The composition of the ore is shown by the following analyses kindly furnished by Mr W. Carey Taylor:

	1	2	3
Ferric oxid (Fe_2O_3)..	46.152	49.757	67.274
Ferrous oxid (FeO)..	20.735	22.354	30.224
Silica (SiO_2).....	31.70	26.134	3.000
Sulfur (S)	.008	.016	.08
Phosphoric acid (P_2O_5)	.005	.016	.165
Alumina (Al_2O_3)....	1.076	1.531	.....
Manganous oxid (MnO)	.037	.090	.....
Lime (CaO)	.364	.315	.....
Magnesia (MgO)...	.872	.229	.....
	100.949	100.442	100.743

Total iron.....	48.43	52.22	70.60
Phosphorus	.002	.008	.07

Analyses 1 and 2 are of crude ore from the Peru Steel Co.'s mines at the north end. No. 3 is of the concentrates from the same locality. It is noticeable that the latter carries higher phosphorus than the former while under ordinary circumstances the opposite should be the case. The general run of ore would be classed as of Bessemer grade. The iron made from it was used mostly in making steel by the crucible process and commanded a relatively high price.

Salisbury mine. This mine is situated 2 miles south of Salisbury Center, Herkimer co. It was exploited to some extent a number of years ago, and recently it has been reopened by the Salisbury Steel & Iron Co. The nearest point of shipment is Dolgeville, the terminus of a short railroad running north from Little Falls. The region lies on the southern border of the Adirondacks, but within the limits of the Precambric formations. The latter are represented by gneisses of varied character. The predominant type is composed in the main of feldspar, augite, hornblende and quartz and is allied to the syenites. Its origin according to Cushing is probably igneous. There are also quartzose gneisses and schists, more or less involved with crystalline limestone, that are to be classed with the Grenville sedimentary formation and small areas of granitic intrusives.[1]

The ore bodies occur within the syenite gneiss. They outcrop in a nearly east-west direction and have a dip of about 75° to the south. The principal deposit is an elongated lens which has been shown to extend several hundred feet along the strike.

A considerable quantity of ore was mined during the early period of operations by open pits and slopes that are now abandoned. The present workings include a vertical shaft that has been sunk to a depth of 150 feet and drifts on the course of the ore body at distances of 100 and 150 feet respectively from the surface. The width of the ore body as shown in these workings ranges from 2 to 12 feet.

The magnetite occurs in bands and irregular masses alternating with rock and also an intimate mixture with the latter. In proximity to the walls the gneiss becomes darker and more basic than the usual country due to the predominance of the hornblende and augite over the feldspar. There is much of this rock all through the ore body, as well as veins of quartz and jasper. The richer material has a massive or platy texture. It runs high in iron, though

[1] Consult Cushing, H. P. Geology of the Vicinity of Little Falls, Herkimer County. N. Y. State Mus. Bul. 77. 1905.

seldom entirely free from inclusions of other minerals. The ore is of non-Bessemer quality, suitable for making basic and foundry irons. Analyses show the presence of titanium in very small quantity.

The existence of ore is indicated by outcrop and magnetic readings at various points to the east and west of the shaft on the line of the main deposit. Little exploration has been done, however, outside the present workings.

Benson mines. The reopening of the Benson mines if carried out according to present plans will add materially to the productive iron ore resources of the State. Though yielding an ore that requires concentration, the deposits are of such size and so favorably situated for operation that they could readily furnish a very large annual output.

The mines are in the town of Clifton, southeastern St Lawrence county, on the Carthage branch of the Rome, Watertown & Ogdensburg railroad. They were last worked during the years 1889-93 by the Magnetic Iron Ore Co. of New York city, who also operated for a time the magnetite mines at Jayville, 14 miles west of the Benson mines. The company erected a mill on the property and about 150,000 tons of high grade concentrates were shipped to Pennsylvania furnaces for making Bessemer and foundry irons. It is a matter of interest that these shipments represent probably the first successful attempt to treat a low grade impure ore so as to yield a Bessemer product.

In his report, Survey of the Third Geological District, Emmons mentions deposits of magnetite situated on the Oswegatchie river in the southeastern part of St Lawrence county and states that large quantities of ore had been taken from this locality to Canton for reduction. From the accompanying description of the deposits it seems likely that the present Benson mines are referred to, though they lie several miles south of the Oswegatchie near the head waters of Little river. Little was done, however, toward active exploitation until the extension of the railroad into the region in 1889.

The ore body outcrops in a ridge extending about 1½ miles in a northeast and southwest direction and rising several hundred feet above the river. Its width is stated by Smock to range from 800 to 1500 feet. Drill holes have penetrated to a depth of 180 feet without passing through the body. Development work has been confined to the superficial portion, the ore being removed by open cast methods. The quarry face is 1500 feet long and 30 feet high.

The ore in general appearance is not unlike the product of some of the mines in the eastern Adirondacks. It has a fine granular texture. The magnetite grains are regularly distributed through a matrix of quartz and feldspar. The quartz is rather more abundant than in most Adirondack ores. A little biotite, pyrite, apatite and red garnet can be identified in the hand specimen. It has been reported that the ore carries spinel, but no mineral answering its description was found by testing, and very likely it has been confused with the garnet. The latter, however, fuses readily under the blowpipe, while spinel is quite refractory.

The average content of the ore in iron is said to be about 33 per cent. Portions of the deposit run as high as 40 or 45 per cent. There is little barren material, and in the former operations all the material quarried was sent to the mill. Analyses of the crude ore (1), concentrates (2) and tailings (3) are given herewith:

	1	2	3
Ferro-ferric oxid (Fe_3O_4)	.....	88.08	1.93
Ferrous oxid (FeO)	.....	.....	5.07
Ferric sulfid (FeS_2)	.....	.864	3.06
Silica (SiO_2)	.....	5.97	59.80
Titanic oxid (TiO_2)	.....	.....	Nil
Phosphoric acid (P_2O_5)	.....	.086	.696
Alumina (Al_2O_3)	.....	2.26	21.75
Manganous oxid (MnO)	.....	2.04	.237
Lime (CaO)	.....	.28	2.27
Magnesia (MgO)	.....	.18	1.75
Potash (K_2O)	.....	.....	.912
Soda (Na_2O)	.....	.....	.326
Water (H_2O)	.....	undet.	undet.
	.....	99.76	97.801
Total iron	34.94	64.18	.....
Manganese	.....	1.58	.....
Sulfur	.48	.461	.....
Phosphorus	.178	.037	.....

The analysis of concentrates represents the result obtained from a combined sample of 132 cars. The phosphorus is well below

the Bessemer limit. Attention may be called to the manganese content which is exceptionally high for Adirondack ores. Its presence is not indicated by the mineral constituents of the crude ore, so that it probably exists in combination with other elements. Only a trace of manganese was found by chemical test in the magnetite, but the garnet gave a very decided reaction. This fact, considered in connection with the small quantity of manganese shown in the analysis of tailings, suggests that the garnet must have been largely carried into the concentrates by the separation process.

Caledonia mine. The Caledonia mine, owned by the Rossie Iron Ore Co., is situated in the town of Rossie, St Lawrence co., 6 miles southwest of Gouverneur. It is one of the group of mines that lies along a narrow belt in Jefferson and St Lawrence counties, and includes the Sterling, Dickson, Keene, Clark as well as many other properties which have been operated at different times in the past. The Caledonia mine is said to have been discovered in 1812.

The ore is an earthy red hematite with occasional masses that have the appearance of specular ore. The associated rocks are crystalline limestone on the foot wall, with serpentine, chlorite and quartz schist forming horses and included bands in the ore body. Overlying the ore in places is Potsdam sandstone in approximately horizontal position. The deposit has a northeasterly strike, while the dip is southeasterly beginning at 45° and gradually flattening in depth. It apparently occupies a trough-shaped depression in the limestone.

The main shaft is down 700 feet on the incline. Levels have been opened 100 feet apart on the course of the ore body. The width varies from 10 to 30 feet, while the workings have an extreme length of about 500 feet and are still in ore. The ore is transported underground by tramways and hoisted in a skip to the surface, where it is subjected to a rough cobbing to separate the accompanying rock. The latter amounts to about one fourth of the material hoisted. The shipments run from 55 to 63 per cent iron. Assays of carload lots furnished by Mr A. J. Cummings, manager for the company, show the following results.

	1	2	3
Iron	58.7	58	56
Phosphorus	.477	.575	.855

Most of the output is shipped to New Jersey furnaces, but a small portion is used by the Rossie Iron Ore Paint Co. at Ogdensburg for paint purposes.

It is expected to increase the production very largely during the present year. A new 20 drill air compressor and other additions to the mining plant are being installed which will facilitate operations.

Old Sterling mine. Work at this mine in the town of Antwerp, Jefferson co., was resumed during the past year by the Old Sterling Iron Co. The mine has been operated since 1836, with occasional interruptions and has yielded a large output. It was last closed down in 1902.

The deposit lies on the contact between Potsdam sandstone which forms the capping and Precambric crystalline rocks. The walls consisting of so called serpentine are irregular and send out offshoots into the ore. The serpentine is considered to be an altered form of granite and gneiss which are exposed in the immediate vicinity of the deposit. Its chemical composition differs materially from that of true serpentine, analysis showing only small amounts of magnesia and much alumina.

The workings include a large open pit at the north, now abandoned, and an extensive system of drifts and chambers from which the output has been obtained in recent years. The ore varies from specular to earthy red hematite. The following analysis has been taken from the report by Smock.

Ferric oxid (Fe_2O_3)	79.52
Silica (SiO_2)	9.80
Sulfur (S)	.08
Phosphoric acid (P_2O_5)	.263
Alumina (Al_2O_3)	1.12
Lime (CaO)	2.49
Magnesia (MgO)	1.07
Water (H_2O)	.68
	95.023
Total iron	55.66
Phosphorus	.115

An analysis of a large shipment from the mine, quoted by Putnam, gave: iron 41.92 per cent; phosphorus .130 per cent.

Clinton mines. The hematite mines at Clinton continue to furnish some ore, though the output for the past year or two has been small, due to the closing down of the blast furnace at Franklin Springs. At present mining is limited to the property of C. A. Borst who supplies ore for paint manufacture, principally to the Clinton Metallic Paint Co.

The deposit from which the ore is obtained is the lower or oolitic bed, consisting of two layers, an upper of 2 feet and a lower of about 8 inches, separated by two feet of rock. It is overlain by 22 feet of shales and thin limestones, above which is the bed of fossil ore from 18 to 24 inches thick. The oolitic ore carries from 40 to 50 per cent iron with an average of about 45 per cent.

Furnaceville mines. The Furnaceville Iron Co. has been engaged for several years in mining ore near Ontario Center, Wayne co. The deposit occurs in the Clinton formation and has a thickness of 22 inches. According to Professor Hall it represents the lower of the two beds which occur in the eastern section of the Clinton, the upper bed of fossil ore not having been found west of Sodus Point, Wayne county. The ore outcrops in an east-west direction across the middle line of Ontario township and has been worked almost continuously for a distance of 5 or 6 miles. Owing to the flat surface and the slight inclination of the strata, which dip southward about one foot in a hundred, open cut methods can be employed to good advantage.

The property of the Furnaceville Iron Co. is situated in the central part of Ontario township on the line of the Rome, Watertown & Ogdensburg railroad. It has been under exploitation for the last 12 years. During this time the workings have progressed gradually southward, necessitating a constantly increasing amount of excavation. At present about 22 feet of shale and earth has to be removed to reach the ore. The method employed consists in opening a long trench parallel to the outcrop and nearly down to the ore. The overburden is first loosened by drilling holes into which heavy charges of powder are placed. After a strip of ground has been broken in this manner, a steam shovel excavates the material and loads it into the bucket of a derrick placed alongside, which transports it to the spoil bank. The last 15 inches of limestone and the underlying ore are taken out by another steam shovel and derrick which loads the ore directly into cars. At present three steam shovels are used in excavating and one in removing the ore.

The ore is an oolitic hematite and resembles that mined at Clinton, though the texture is somewhat coarser. It averages about 43 per cent iron. The following analyses of the product of different mines in this region are taken from the paper by Putnam in the reports of the 10th census.

	1	2	3	4
Iron	41.46	40.73	42.25	38.36
Phosphorus	.578	.531	.481	.471

No. 1 is from the mines formerly worked by the Ontario Furnace Co., no. 2 from the Hurly ore bed, no. 3 from La Frois ore bed, and no. 4 from the Bundy ore bed.

Amenia mine. This mine is at present the single producer of limonite ore in the State. It is situated near Amenia station, Dutchess co., in the well known Salisbury district.

The ore body occurs along the contact of a black micaceous schist (Hudson River series) with underlying crystalline limestone (Stockbridge) which is correlated with the Cambro-Siluric limestones farther north and west. The strata trend a little east of north and dip steeply (60°-70°) to the east. While limonite is the principal ore some carbonate has been found in the bottom workings, particularly at the south end; its association with the ore is interesting and substantiates the view commonly held by geologists that most if not all of the deposits in the district have been formed by oxidation of iron carbonate. The limonite occurs in compact bodies in pockets, mixed with clay, and in spheroidal or cup-shaped masses. It is crushed and washed to remove the clay. Analyses quoted by Putnam show the following composition.

	1	2
Iron	48.28	48.99
Phosphorus	.092	.413
Sulfur	.....	.152

No. 1 is from the Amenia mine proper and no. 2 from the adjoining Gridley pit to the south. The iron made from this ore was formerly used in the manufacture of car wheels, gun castings and materials requiring a strong, tenacious metal.

Bibliography

Ball, Clinton M. The Magnetic Separation of Iron Ore. Am. Inst. Min. Eng. Trans. v. XXV. 1895.
Beck, Lewis C. Mineralogy of New York. 1842.
Emmons, E. Geology of New York: Report on Second District. 1842.
Hall, C. E. Laurentian Magnetite Iron-ore Deposits in Northern New York. N. Y. State Mus. 32d An. Rep't. 1879.
Hall, James. Geology of New York: Report on Fourth District. 1843.
Kemp, J. F. Geology of Moriah and Westport Townships, Essex County, N. Y. N. Y. State Mus. Bul. 14. 1895.
—— The Geology of the Magnetites near Port Henry, N. Y., and especially those of Mineville. Am. Inst. Min. Eng. Trans. v. XXVII.
—— Titaniferous Iron Ores of the Adirondacks. U. S. Geol. Sur. 19th An. Rep't. pt 3. 1899.
Putnam, B. F. Notes on the Samples of Iron Ores Collected in New York. U. S. 10th Census Rep't. v. XV. 1886.
Smock, J. C. First Report on the Iron Mines and Iron Ore Districts in the State of New York. N. Y. State Mus. Bul. 7. 1889.
Smyth, C. H. jr. Report on the Geology of the Four Townships in St Lawrence and Jefferson counties. N. Y. State Mus. 47th An. Rep't. 1894.
—— On the Clinton Iron Ore. Am. Jour. Sci. v.XLIII. 1892.

MARL

Under this head are included the soft pulverulent or loosely aggregated deposits of calcium carbonate. They have the essential characters of limestones, from which they are distinguished by their unconsolidated character and somewhat greater content of mechanically absorbed water.

The marls of New York State are of recent formation, being associated with superficial beds of clay, sand and peat which have been laid down during the Quaternary period. Swampy areas and the basins of drained lakes frequently contain deposits. Wherever bodies of standing water have existed, the dissolved lime brought in by tributary springs and streams may have had opportunity to precipitate, a process that is facilitated by evaporation as well as by increased temperature of the water. In some cases lime is deposited directly by springs and rivers owing to loss of the excess carbon dioxid which holds it in solution. Its precipitation as an incrustation on vegetable growth, such as grasses and mosses, leads to the formation of tufa or travertine. Marls almost always contain the common varieties of shells found in fresh water and at times these are so abundant that whole beds are largely composed of their remains.

The most extensive marl deposits are found in the central and western parts of the State. The frequent occurrence of limestones in the underlying geologic formations of this section has supplied abundant calcareous material for solution by ground waters. Moreover the drift and clays at the surface contain much lime in a comminuted easily soluble condition.

Marl serves many of the purposes for which limestone is commonly used. As a rule it contains a higher percentage of calcium carbonate than limestone and is correspondingly freer from magnesia, silica, alumina and other impurities. It is, therefore, well adapted for Portland cement manufacture. When briquetted and burned it yields an excellent lime. Marl is also employed as a fertilizer either directly or as a filler in artificial fertilizers and in the manufacture of whiting and carbon dioxid.

Distribution. In Madison county marl occurs in the marshy tracts south of Oneida lake. Cowaselon swamp extending west from Canastota contains several thousand acres of marl deposits which are in most cases covered by peat. The beds are said to reach a thickness of 30 feet.

Marls are extensively developed in the swamps and lakes of Onondaga county, particularly in Fabius, Tully, Camillus, DeWitt, Man-

lius, Elbridge and Van Buren townships. Onondaga and Cross lakes contain deposits. Some localities afford very pure material, yielding an excellent white lime when burned. The marls have been employed to some extent for this purpose and for fertilizer, but the principal application at present is in Portland cement manufacture. The Empire Portland Cement Co. works a deposit near Warners, which is 6 to 7 feet thick and is underlain by blue clay. The two substances are mixed and burned into cement. The American Portland Cement Co. owns marl lands near Jordan, but its plant is not now in operation.

The Montezuma marshes covering a large area north of Cayuga lake in Cayuga and Seneca counties are reported to be underlain by marl. At Montezuma a deposit 14 feet thick was opened by a cement company which is now inactive.

In Wayne county, the Cayuga marshes which occupy a part of the town of Savannah contain a deposit of shell marl 5 to 6 feet deep. Other beds occur near Newark and in Cooper's swamp, town of Williamson.

Steuben county possesses numerous deposits of marl and tufa. According to Hall[1] they have been used for lime burning at Arkport and south of Dansville. In the town of Wayland the Portland cement works of Thomas Millen Co. and the Wayland Portland Cement Co. employ marl which is obtained from local beds, ranging from 2 to 14 feet thick.

In the southern part of Monroe county there is a large deposit which occupies a portion of the town of Wheatland and extends south into Livingston county. Tufa forms the upper part at some places, and beneath is shell marl, 3 to 4 feet thick.[2] Another deposit is found along Mill creek, underlying extensive marshes. At Mumford several beds have been found.

In Livingston county the most important deposits occur near Caledonia. The Iroquois Portland Cement Co. has recently erected a plant at this locality. The Caledonia Marl & Lime Co. is engaged in the production and preparation of marl for fertilizing and other purposes.

There are many marl swamps in Genesee county. An extensive deposit occurs 1 mile west of Bergen. Around Leroy and Batavia several beds have been located.

In Wyoming county the bottom of Silver lake is said to consist in part of marl.

[1] Geol. N. Y. 4th Dist. 1843. p. 484.
[2] Op. cit. p. 428.

In Chautauqua county Cassadaga lake and the bordering marshes contain marl. A Portland cement plant was built some years ago to utilize the deposit, but has since been closed down. The marl has been used to some extent for lime.[1] At the southern extremity of Chautauqua lake, both marl and tufa are found.

The following additional occurrences have been noted by Beck[2] and others: Along Tonawanda creek and near Lockport, Niagara co.; Clarendon, Orleans co.; near Lodi, Seneca co.; Beaver Dams, Schuyler co.; Cortland, Cortland co.; Horseheads and Millport, Chemung co.; Canajoharie, Fort Plain and Fonda, Montgomery co.; town of Cherry Valley, Otsego co.; 4 miles south of Kinderhook, Columbia co.; town of New Baltimore, Greene co.; and towns of Rhinebeck, Northeast, Pine Plains, Stanford and Red Hook, Dutchess co.

Chemical analyses. The marls are usually quite pure. Compared with most limestones they contain much less magnesia and clayey material. The following analyses may be considered representative of the marls found in New York State. They are based on the dry material and thus show a higher percentage of carbonates than would be the case with the crude marls.

	1	2	3	4	5
Silica (SiO_2)	6.22	.67	.26	.42	.50
Alumina (Al_2O_3)	1.70	1.07	.10	1.08	2
Ferric oxid (Fe_2O_3)	.86	.13			
Lime (CaO)	47.86	54.53	52.86	52.36	52.70
Magnesia (MgO)	.04	.19	.18	1.01	1.09
Carbon dioxid (CO_2)	42.11	43.05	41.73	42.26	42.61
Water etc	*a* 2.20	.34	4.64	*b* 2.87	.....
	100.99	99.98	99.77	100.00	98.90

a Alkalis. *b* Includes $CaSO_4$, 2.01%.

(1) Marl from Montezuma, Cayuga co. (2) Caledonia Marl & Lime Co., Caledonia, Livingston co. (3) Marl used by Empire Portland Cement Co., Warners, Onondaga co. (4) Thomas Millen Co., Wayland, Steuben co. (5) Calcareous tufa, Mumford, Monroe co.

Bibliography

Hall, James. Geology of New York: Report on Fourth District. 1843.

Marshall, W. B. Report on deposits of marl and peat in the town of New Baltimore, Greene county. N. Y. State Mus. 45th An. Rep't. 1892. p.46–52.

Ries, H. & Eckel, E. C. Lime and Cement Industries of New York. N. Y. State Mus. Bul. 44. 1901.

Vanuxem, Lardner. Geology of New York: Report on Third District. 1839.

[1] Op. cit. p. 496.

[2] Mineralogy of New York. 1842.

MILLSTONES

Millstones are obtained in Ulster county. The industry is a small one, but it has been established for more than a century and still furnishes most of the millstones made in this country. The product is known as Esopus stone, Esopus being the early name for Kingston, once the principal point of shipment.

The millstones are quarried from the Shawangunk grit, a light gray quartz conglomerate found along the Shawangunk mountain from near High Falls southwest toward the Pennsylvania border. The Cacalico stone obtained in Lancaster county, Pa. and the Brush mountain stone, found in Montgomery county, Va. are of similar character. In Ulster county the grit rests upon the eroded surface of gray Hudson River shales and is overlain by red shale. It has generally been correlated with the Oneida conglomerate of central New York, though recent investigations tend to show that it belongs higher up in the series, probably in the Salina. Its thickness ranges from 50 to 200 feet.

The grit is composed of quartz pebbles of milky color inclosed in a silicious matrix. The pebbles are more or less rounded and vary from a fraction of an inch up to 2 inches in diameter. The texture is an important factor in determining the value and particular use of the finished millstones.

In quarrying advantage is taken of the joints which intersect the strata. There are usually two systems of joints, the one transverse and the other longitudinal to the strike. By selection, a block of approximate dimensions to make a disk of any desired size can be obtained. The blocks are roughly shaped by drilling holes and splitting with wedges. They are then cut to shape and undergo a final tool-dressing which varies with the use to which they are to be put.

The sizes of the stones marketed range from 15 to 90 inches. The greater demand is for the smaller and medium sizes, with diameters of 24, 30, 36, 42 and 48 inches. A pair of 30 inch millstones commonly sells for $15, while $50 may be paid for a single stone 60 inches in diameter. The largest sizes bring from $50 to $100. Besides the common type of millstones, disks are furnished which are employed in a roll type of crusher known as a chaser. The pavement of such crushers is also supplied by the quarrymen in the forms of blocks. Quartz, feldspar and barytes are commonly ground in chasers.

Most of the Ulster county quarries are situated along the northern edge of the Shawangunk mountain. Kyserike, St Josèn, Granite

and Kerhonkson are the principal centers of the industry, while the distributing points include New Paltz and Kingston in addition to those named. The industry is carried on intermittently, many of the producers engaging in other occupations during a part of the year.

The market for millstones has been curtailed of late years by the introduction of rolls, ball mills and other improved forms of grinding machinery. The roller mill process has displaced the old type of cereal mills, particularly in grinding wheat. The small corn mills distributed throughout the southern states, however, still use millstones and furnish one of the important markets for the New York quarries. A part of the product also is sold to cement and talc manufacturers.

The production of millstones in 1905 amounted to a value of $22,944. There were 19 firms engaged in the business. In the previous year the output was valued at $21,476, reported by 18 firms. At one time the value of the product from this section exceeded $100,000 annually.

Bibliography

Mather, W. W. Geology of New York: Report on First District. 1843. p.357.

Nason, F. L. Economic Geology of Ulster county. N. Y. State Geol. 13th An. Rep't. 1894. 1:373.

MINERAL PAINT

The term mineral paint is here used to designate the natural mineral colors obtained by grinding an ore or rock. The materials suitable for this purpose that are found in New York State include iron ore, shale, slate and ocher.

For metallic paint and mortar colors some form of iron ore, generally hematite or limonite, is commonly employed, but only a few localities are known where the ore possesses the requisite qualities of color and durability. The fossil hematite from the Clinton formation is perhaps most widely used in this country. The mines owned by C. A. Borst at Clinton, Oneida co. and those of the Furnaceville Iron Co. at Ontario, Wayne co. supply much of the crude material. The red hematite mined by the Rossie Iron Ore Co. at Rossie, St Lawrence co. also yields a good metallic paint.

Mineral paint made from shale and slate is quite extensively used for wooden structures. When there is a considerable percentage of iron oxids present, the shale and slate may be sold for metallic paint. Their value depends largely upon the depth and durability

of their color; but the degree of natural fineness and the amount of oil required in mixing must also be considered in determining their utility. At Randolph, Cattaraugus co. beds of green, brown and bluish shale occur in the Chemung formation. They are worked by the Elko Paint Co. In years past red shale has been obtained in Herkimer county from the Vernon beds at the base of the Salina. A similar material occurring in the Catskill series has been worked at Roxbury, Delaware co. The red slate of Washington county, which belongs in the Cambric, is also ground for paint. The Algonquin Red Slate Co., of Worcester, Mass. and A. J. Hurd of Eagle Bridge produce this material.

A product known as mineral black is made by grinding slate found in the Hudson River series.

The ferruginous clay called ocher occurs quite commonly in the State, but no deposits are exploited at present. A bed occurring on Crane mountain, Warren co. once supplied a considerable quantity.

Sienna, a variety of ocher, occurs near Whitehall. The deposit is a thin stratum in glacial drift and has been worked on a small scale.

In addition to the producers above mentioned, the Clinton Metallic Paint Co. of Clinton, and the William Connors Paint Manufacturing Co. of Troy, are engaged in the manufacture of mineral paints from New York materials.

The production of mineral paints in 1905 was as follows: metallic paint and mortar color, 6059 short tons, valued at $70,090; slate pigment, 2929 short tons, valued at $22,668. In the year 1904 the following quantities were reported: metallic paint and mortar color, 4740 short tons, $55,768; slate pigment, 3132 short tons, valued at $23,876. These totals include only the output made within the State from local materials. A part of the crude material produced each year is shipped to points outside of the State for manufacture. An output of 10,050 tons was reported in 1905 by four firms who sell the crude ore and rock to paint grinders.

MINERAL WATERS

The mineral springs of New York afford a variety of waters suited for medicinal or domestic purposes. Over 200 different springs have been listed and classified according to their mineral composition, though many find no commercial application except, perhaps, as sources of local water supply. Some of the springs are places of resort for tourists and health seekers.

Among the waters that contain mineral ingredients in appreciable quantity, those characterized by the presence of alkalis and alkaline earths are the most abundant in this State. The dissolved salts may exist principally in the form of chlorids and carbonates, as is the case with the springs of Saratoga county, or they may be combined with sulfuric acid to form sulphates, as illustrated by the Sharon and Clifton springs.

The mineral waters of Saratoga Springs and Ballston are found along fractured zones in Lower Siluric strata. They supply large quantities of table and medicinal waters which are shipped to almost every part of the country. Sodium and potassium chlorids and the carbonates of lime, sodium and magnesium are the main constituents. The amount of dissolved salts in the different waters varies from less than 100 to over 500 grains per gallon. Free carbon dioxid occurs in great abundance and is an important article of commerce.

The waters at Richfield Springs contain sulfates of the alkalis and alkaline earths, with subordinate chlorids and carbonates and sulfureted hydrogen. They are employed in medicinal baths as well as for drinking purposes. The springs issue along the contact of Siluric limestone and Devonic shales. The Sharon springs which lie to the east of Richfield Springs are situated near the contact of the Lower and Upper Siluric. Clifton Springs, Ontario co. and Massena Springs, St Lawrence co. are among the other localities where sulfureted waters occur and are utilized.

The Oak Orchard springs in the town of Byron, Genesee co. are noteworthy for their acid waters, which contain a considerable quantity of aluminum, iron, calcium and magnesium, besides free sulfuric acid.

The Lebanon spring, Columbia co. is the single representative of thermal springs in the State. It has a temperature of 75° F. and is slightly charged with carbon dioxid and nitrogen.

In addition to the foregoing, there are a number of localities that afford mineral waters of commercial value. Quite a large industry also is based on the sale of spring waters for table use. Such waters contain very little mineral salts, their value depending upon their freedom from harmful impurities. The Great Bear spring at Fulton may be mentioned as an example of this class.

List of springs. In the following list are included the names of the leading mineral springs in the State and their location. Nearly all are employed for commercial purposes, or have recently been so employed.

NAME	LOCATION
Baldwin Mineral Spring	Cayuga, Cayuga co.
Chautauqua Lithia Spring	Westfield, Chautauqua co.
Breesport Oxygenated Mineral Springs	Breesport, Chemung co.
Chemung Spring	Chemung, Chemung co.
Rockdale Mineral Spring	Rockdale, Chenango co.
Lebanon Mineral Spring	Lebanon Springs, Columbia co.
Knickerbocker Spring	Fishkill, Dutchess co.
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Avon Spring	Avon, Livingston co.
Jackson's Sanitarium	Dansville, Livingston co.
Clinton Lithia Spring	Franklin Springs, Oneida co.
Franklin Lithia Spring	Franklin Springs, Oneida co.
Glacier Spring	Franklin Springs, Oneida co.
Lithia Polaris Spring	Boonville, Oneida co.
Split Rock Spring	Franklin Springs, Oneida co.
Verona Mineral Springs	Verona, Oneida co.
Warner's Natural Mineral Spring	Franklin Springs, Oneida co.
Clifton Springs	Clifton Springs, Ontario co.
Geneva Lithia Mineral Water Spring	Geneva, Ontario co.
Geneva Red Cross Lithia Spring	Geneva, Ontario co.
Fitzsimmons Spring	Port Jervis, Orange co.
Deep Rock Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
Oswego Mineral Spring	Oswego, Oswego co.
White Sulphur Springs	Richfield Springs, Otsego co.
Massena Springs	Massena Springs, St Lawrence co.
Arondack Spring	Saratoga Springs, Saratoga co.
Artesian Lithia Spring	Saratoga Springs, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Empire Spring	Saratoga Springs, Saratoga co.
Eureka White Sulphur & Mineral Spring	Saratoga Springs, Saratoga co.
Excelsior Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
Hides Franklin Spring	Ballston Spa, Saratoga co.

NAME	LOCATION
High Rock Spring	Saratoga Springs, Saratoga co.
Lincoln Spring	Saratoga Springs, Saratoga co.
Old Putnam Mineral Spring	Saratoga Springs, Saratoga co.
Patterson Mineral Spring	Saratoga Springs, Saratoga co.
Quevic Spring	Saratoga Springs, Saratoga co.
Royal Vichy Spring	Saratoga Springs, Saratoga co.
Star Spring	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring	Saratoga Springs, Saratoga co.
Saratoga Vichy Spring	Saratoga Springs, Saratoga co.
Saratoga Victoria Spring	Saratoga Springs, Saratoga co.
Chalybeate Spring	Sharon Springs, Schoharie co.
Magnesia Spring	Sharon Springs, Schoharie co.
White Sulphur Spring	Sharon Springs, Schoharie co.
Red Jacket Mineral Spring	Seneca Falls, Seneca co.
Mountain Mist Spring	West Hills, Suffolk co.
Dryden Springs	Dryden, Tompkins co.
Big Indian Spring	Ellenville, Ulster co.
Elixir Spring	Clintondale, Ulster co.
Vita Spring	Fort Edward, Washington co.
Clyde Mineral Spring	Clyde, Wayne co.

Production. The commercial production of mineral waters constitutes a large and growing industry. The present output of the State, based on returns received for the year 1904, is about 8,000,000 gallons annually, on which a nominal valuation of $1,600,000 is placed. The springs of Saratoga county alone reported sales of 1,695,936 gallons in that year, representing a total value of $419,364. The canvass of the industry is attended with some difficulty. Many springs are exploited intermittently or on a small scale, and no accurate account is kept by the owners as to the actual sales. A number of springs are also used locally to supply hotels and sanatoriums, so that only an approximate estimate can be secured for their output.

Bibliography

Beck, Lewis C. Mineralogy of New York. 1842.
Merrill, F. J. H. Mineral Resources of New York State. N. Y. State Mus. Bul. 15. 1895.
Peale, Albert C. Mineral Springs of the United States. U. S. Geol. Sur. 14th An. Rep't. 1894. pt 2.

NATURAL GAS

Natural gas is produced in 13 counties of the State. The most prolific fields are in the southwestern part, including Allegany,

Cattaraugus, Chautauqua and Erie counties. The adjoining section to the east contains scattered pools, mostly of small extent, and there are a number of wells within the belt bordering Lake Ontario from Jefferson to Niagara county. It is said that the first attempt to use natural gas for light and heat in this country was made at Fredonia, where shallow wells were drilled as early as 1821.

The supply of natural gas is derived from several geologic horizons, its range extending from the Potsdam sandstone in the Cambric to the Chemung stage at the top of the Devonic. There are, however, certain formations that are characteristic for its occurrence in New York State. They comprise the Trenton limestone of the Lower Suluric, Medina sandstone of the Upper Siluric and Portage and Chemung shales with interbedded sandstones of the Devonic. With few exceptions the gas pools of the different fields are associated with one or another of these formations.

The oil field of Allegany and Cattaraugus counties has produced large quantities of natural gas from the Devonic. The pools of oil and gas are found in sandstones at different horizons, such as the Bradford, Kane and Elk "sands" in the Chemung. Some of the supply is consumed in the gas engines employed for pumping the oil, and the remainder is used for light and fuel in the local towns and villages. The industry is controlled by a few companies who own the distributing pipe lines. The Empire Gas & Fuel Co. of Wellsville, and the Andover Gas Co. and the Mutual Gas Co., of Andover, are the principal operators. Some of the leading towns supplied from this field are Olean, Andover, Wellsville, Friendship, Hornellsville and Geneseo. In the northwestern part of Cattaraugus county there is a small field of which Gowanda is the center and which extends across the border into Erie county. The gas is said to occur in the Marcellus and Onondaga formations of the Middle Devonic. The wells when first put down were very productive, yielding as high as 10,000,000 cubic feet daily. The Gowanda Gas Co. distributes the output which is mainly used in Gowanda.

In Chautauqua county the productive area comprises a belt bordering Lake Erie from Silver Creek southwest to the Pennsylvania state line. The gas is contained in the Portage and Chemung beds. The wells are mostly shallow and the individual yield is only sufficient to supply a few families with gas. They are located principally around Silver Creek, Dunkirk, Fredonia, Brocton, Westfield, Mayville and Ripley. Some deep drilling has been done recently for the purpose of exploring the formations below the Devonic. At

Silver Creek, the South Shore Gas Co. and the Silver Creek Gas & Improvement Co. opened several wells during 1904 which were quite productive, the gas being found in the Medina at a depth of about 1700 feet. The output is consumed at Silver Creek, Forestville and Dunkirk. Two wells were drilled at Brocton by the Brocton Gas & Fuel Co. The Medina sandstone was encountered at a depth of 2225 feet and one well yielded 10,000 cubic feet daily, while the second gave only a small flow of sulfurous gas from the Devonic strata.

Erie county contains several fields. A few successful wells have been put down within the limits of Buffalo. East Aurora, Collins, North Collins and Springville in the southern part produce small quantities. Since 1889 a field has been opened east of Buffalo, in the towns of Cheektowaga, Amherst, Lancaster, Clarence, Alden and Newstead, which is now the most active in the State. The gas is found in the Medina sandstone. The wells are quite prolific, yielding as high as 1,000,000 cubic feet daily. They are connected by pipe lines with Buffalo, Tonawanda, Akron, Batavia, Lancaster, Depew, Honeoye Falls and other towns in the vicinity.

In Genesee county there are a few wells at Corfu. A small output is made at Attica, Wyoming co.; Avon, Lima and Caledonia, Livingston co.; and in the towns of East Bloomfield and West Bloomfield, Ontario co.

Farther east in Onondaga county, a limited supply is obtained at Baldwinsville and Phoenix. An interesting occurrence of gas is reported at Warner in this county where a well was drilled in 1897 to a depth of 3525 feet. No flow was encountered at the usual horizon, the Trenton, but a pool was struck near the bottom in what has been regarded as the Potsdam sandstone. The well is now about exhausted.

Oswego county produces a small quantity of gas, the wells being located at Fulton, Pulaski and Sandy Creek. This marks the present eastern limit of the gas fields of the State.

Production. The value of the output of natural gas in 1905, as compiled from the returns of producers and pipe line operators, was $607,000. The output in 1904 was valued at $552,197, showing an increase of $54,803 for the year. At the rate of 23 cents a thousand cubic feet, which was the average selling price reported by the leading distributing companies for the two years, the estimated quantity of natural gas produced was 2,639,130,000 cubic feet in 1905 and 2,399,987,000 cubic feet in the previous year.

Production of natural gas

COUNTY	1904	1905
Allegany-Cattaraugus	$183 830	$204 430
Chautauqua	31 822	26 232
Erie	254 899	281 253
Livingston *a*	32 451	41 805
Onondaga	15 350	16 825
Oswego	14 990	13 583
Wyoming *b*	18 855	22 872
Total	$552 197	$607 000

a Includes also Seneca, Ontario and Yates counties.
b Includes also Niagara and Genesee counties.

These quantities are approximately equivalent in heating value to 130,000 and 120,000 tons, respectively, of coal. The values reported by the individual companies ranged from a minimum of 18 cents to a maximum of 50 cents a thousand cubic feet. The average for the greater part of the output was about 25 cents.

Owing to the fact that some of the larger companies operate at several localities, it is difficult to distribute the output according to the districts in which it was made. The following statistics are, however, close approximations, those for 1904 being inclosed in brackets: Allegany-Cattaraugus field $204,430 [$183,830]; Erie county $281,253 [$254,899]; Chautauqua county $26,232 [$31,822]; Niagara, Wyoming and Genesee counties $22,872 [$18,855]; Livingston, Seneca, Ontario and Yates $41,805 [$32,451]; Onondaga county $16,825 [$15,350]; Oswego county $13,583 [$14,990]. The largest increases were in Erie county, which showed a gain of $26,354, and in the Allegany-Cattaraugus field which gained $20,600. In the other districts there were no important changes.

There was a good deal of exploration carried on during the year, which has added some new territory to the proved gas fields of the State. Two wells were drilled by G. W. Warner near Alpine in southeastern Schuyler county. In the first, pockets of gas were encountered at 720 feet in chocolate sandstone and at 955 feet in shale, but nothing further was found to the depth of 1824 feet where drilling ceased. The second well was put down to a depth of 733 feet, with a little gas at 629 feet and a larger flow at 667 feet, registering 86 pounds. Salt water was encountered in both wells. At Wellsburg, Chemung county, a well was drilled by the Ashland Natural Gas Co., to a depth of 1700 feet, passing most

of the distance through shale. Only small pockets of gas were found. The Rushville Membership Gas & Oil Pool drilled two wells near Rushville, Yates co. One well gave an estimated flow of 50,000 cubic feet daily from a depth of 378 feet, while the other yielded a little gas which was encountered at 425 feet. At Pavilion, Genesee co., the Pavilion Natural Gas Co. put down a well to a depth of about 2000 feet, which is reported to have been successful.

Bibliography

Ashburner, C. A. Petroleum and Natural Gas in New York State. Am. Inst. Min. Eng. Trans. 1887. v.16.
Bishop, I. P. Petroleum and Natural Gas in Western New York. N. Y. State Geol. 17th An. Rep't. 1899.
—— Oil and Gas in Southwestern New York. N. Y. State Geol. 19th An. Rep't. 1901.
Orton, Edward. Petroleum and Natural Gas in New York. N. Y. State Mus. Bul. 30. 1899.

PEAT

The swamp lands of the State quite commonly contain peat beds. It has been estimated that the inundated lands cover from 2000 to 3000 square miles, or approximately $\frac{1}{20}$ of the entire surface, though of course the occurrence of peat is not equally extensive. The beds have been worked on a small scale only, principally for agricultural purposes. An impure peat, commonly called muck, is generally used, as the impurities increase the fertilizing value. Experiments have been undertaken recently, with the view to manufacturing peat fuel. A small plant has been erected near New Rochelle by the Peat Koal Co., of New York. The peat is pulped and compressed in a Schlickeysen machine, which consists essentially of a cylinder provided with a rotating axis that carries projecting blades. The compressed peat issues in the form of a continuous block which is cut into convenient lengths for handling.

The occurrence of peat in New York has been described very fully in the early reports of Beck, Mather and Hall and more recently in the papers by Ries and Parsons, to which reference will be found under the appended bibliography. The following paragraph is quoted from the paper by Parsons.

It would be difficult to find a spot in the entire State that is more than 10 miles from a swamp, and though not all swamps furnish peat, yet it is within the limits of probability that peat will be found in at least half of them. The most extensive group of swamps is found in the Finger lake region and the lowlands near the St Lawrence river, though the largest swamp of all, the Drowned Lands of the Wallkill, is in the mountainous part of Orange county,

which borders on New Jersey. Many peat deposits are found in the Adirondacks, and, as exploration is carried on farther, the recorded number will be much greater. The depth of the Adirondack swamps is likely to be greater than that of most of the swamps in the central and western portions of the State, though the few visited by the author are not very deep.

Bibliography

Beck, Lewis C. Mineralogy of New York. 1842.
Hall, James. Geology of New York: Report on Fourth District. 1843.
Mather, W. W. Geology of New York: Report on First District. 1843.
Parsons, A. L. Peat, its Formation, Uses and Occurrence in New York. N. Y. State Geol. 23d An. Rep't. 1904.
Ries, H. Uses of Peat and its Occurrence in New York. N. Y. State Geol. 21st An. Rep't. 1903.

PETROLEUM

The oil-bearing territory of New York embraces the northeastern part of the Appalachian field and is limited to the counties of Cattaraugus, Allegany and Steuben. The first well was drilled in Cattaraugus county in 1865. The Allegany county field was not developed till some 15 years later. In 1902 there was a total of 8443 producing wells in the State.[1] The productive strata are fine grained sandstones, locally called black sands, belonging to the Chemung formation of the Upper Devonic. The oil varies from amber to black in color.

The Cattaraugus county oil wells are located on an extension of the Bradford district which lies mostly in Pennsylvania. The productive area within New York State comprises about 40 square miles, the greater part being in Olean, Allegany and Carrollton townships. The pools occur at several horizons from 600 to 1800 feet below the surface. Some of the more notable ones are the Ricebrook, Chipmunk, Allegany and Flatstone. Though very prolific when first opened, the daily yield now averages less than one barrel per well.

The oil field of Allegany county extends across the southern townships of Clarksville, Genesee, Wirt, Bolivar, Alma, Scio and Andover. It is divided into several pools, which have been considered to be more or less independent. The Bolivar, Richburg and Wirt pools were first opened and have been the most productive. The oil sand is found at depths varying from 1400 to 1800 feet. The Andover pool, discovered in 1889, lies partly in the town of West Union, Steuben co. The wells are from 850 to 1000 feet deep.

[1] Bureau of the Census, Mines and Quarries. 1902.

Though there have been few new developments in the way of extending the oil territory, the industry has shown remarkable stability. Compared with other fields of the country the records indicate that the New York wells have a long life. The production is also favored by the superior quality of the oil, which commands a high price at the refineries, and by the occurrence of natural gas in quantities that generally suffice to furnish the power required for pumping. During late years the demand has been such that wells yielding less than one half barrel daily could be profitably worked.

[a]Production of petroleum in New York

YEAR	BARRELS	VALUE
1891	1 585 030	$1 061 970
1892	1 273 343	708 297
1893	1 031 391	660 000
1894	942 431	790 464
1895	912 948	1 240 468
1896	1 205 220	1 420 653
1897	1 279 155	1 005 736
1898	1 205 250	1 098 284
1899	1 320 909	1 708 926
1900	1 300 925	1 759 501
1901	1 206 618	1 460 008
1902	1 119 730	1 530 852
1903	1 162 978	1 849 135
1904	1 036 179	1 709 770
1905	949 511	1 566 931

[a]The statistics for the years 1891-1903 inclusive are taken from the annual volumes of the *Mineral Resources*.

The output of the New York wells in 1905, as indicated by shipments of the companies operating pipe lines, amounted to 949,511 barrels of 42 gallons. The value of the production at an average of $1.65 a barrel was $1,566,931. In 1904 the total reported was 1,036,179 barrels, valued at $1,709,770, showing a decrease in quantity of 86,668 barrels and in value of $142,839. The following companies have pipe lines in this State: The Allegany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co., Fords Brook Pipe Line Co., and the Vacuum Oil Co., of Wellsville, N. Y., and the Tide Water Pipe Co., Limited, of Bradford, Pa.

Bibliography

Ashburner, C. A. Petroleum and Natural Gas in New York State. Am. Inst. Min. Eng. Trans. 1887. v.16.

Bishop, I. P. Petroleum and Natural Gas in Western New York. N. Y. State Geol. 17th An. Rep't. 1899.

—— Oil and Gas in Southwestern New York. N. Y. State Geol. 19th An. Rep't. 1901.

Orton, Edward. Petroleum and Natural Gas in New York. N. Y. State Mus. Bul. 30. 1899.

PYRITE

The commercial production of pyrite is at present confined to St Lawrence county, where mining has been carried on intermittently for several years. The deposits are associated with crystalline limestones and schists of the Grenville series. They apparently represent impregnated zones in the schist, or fahlbands, though subject to local enrichment which may take the form of lenses and shoots like those encountered in the Adirondack magnetite deposits. The zones have a northeasterly strike conformable to the wall rock. The more important are found in a belt extending from near Gouverneur northeast to High Falls in the town of Canton.

The Stella mine, 1 mile northeast of Hermon, was the first opened in the district. It has been operated at various times, and was last closed down in 1900. It is now owned by the St Lawrence Pyrite Co. There are five parallel deposits on the property, of which two have been developed.[1] The western ore body, which has been the main producer, is opened by an incline 700 feet deep driven at an angle of 30°. The ore is removed by extending drifts at intervals of 30 to 50 feet along the incline, leaving pillars to support the roof. An average thickness of 12 feet is shown in the slopes, while the length of the workings is about 200 feet. An extension of the ore body to the south has been found by recent exploration. The company mined a considerable quantity of ore during the past year, and awaits the construction of a mill before making shipments. A mill of 500 tons daily capacity is now under way.

The High Falls mine is situated south of Canton near the Grass river. It is opened by two slopes, sunk on different shoots, the latter being separated by a mass of gangue and pyrrhotite. The walls have a westerly dip, while the shoots pitch to the north. The first slope driven on the southern shoot has been used in removing the ore from the upper levels. The second slope on the northern shoot was put down to avoid opening long drifts. The mine was worked for some time by the High Falls Pyrite Co. It has recently been taken over by the National Pyrites Co., who started operations late in 1905. The mill has a daily capacity of 50 tons crude ore.

The Cole mine, 4 miles north of Gouverneur, has been the largest producer in the last few years. It was first opened as a pit on the outcrop and later by an incline which was put down 150 feet at an angle of 30°. The workings are about 100 feet on the strike and

[1]For a detailed description of the pyrite mines of St Lawrence county, reference should be made to the article by R. B. Brinsmade, Eng. & Min. Jour. Oct. 28, 1905.

from 8 to 12 feet wide. By extending a crosscut through the hanging wall, a second deposit was found which has been shown by exploration to be at least 100 feet long and 60 feet thick. The mine is owned by the Adirondack Pyrite Co. The equipment includes a large mill.

Besides the three mines mentioned there are a number of openings and prospects in the vicinity. Some ore has been taken from a deposit on the Alexander Farr farm, 2½ miles northeast of Bigelow in De Kalb township. The existence of pyrite is reported also on the properties of George Styles 1½ miles west of Bigelow; of S. Hendricks 1 mile south of Bigelow; and of L. Hockins, 7 miles west of Rensselaer Falls, town of De Peyster. Another locality is the Graham pit 2 miles northeast of the Stella mine.

The crude ore from the St Lawrence county mines carries from 20 to 35 per cent sulfur. An analysis of average material from the Stella deposit shows the following percentages: sulfur 33%; silica, 32%; iron, 32%; copper .04%, with traces of gold and silver. By concentration the sulfur content is raised to 45 or 50 per cent.

In the mill owned by the Adirondack Pyrites Co., the ore as it comes from the mine is passed through a Blake crusher and rolls where it is broken down to $\frac{3}{16}$ inch size. It is then concentrated on Hartz jigs. Each of the four jigs used has three beds. From here the concentrates are elevated and loaded into cars for shipment or held in storage. About 5 per cent of sulfur is lost in the tailings. The cost of mining and milling is said to be about 75 cents a ton of concentrates.

The pyrite is used in making sulfuric and sulfurous acids. It has been shipped to chemical companies in New York and adjoining states. The sulfite pulp mills in the Adirondacks consume large quantities of sulfurous acid and should afford an excellent market for the output of this region. The pyrite contains no impurities that interfere with its use for manufacturing acids.

On the eastern side of the Adirondacks the schists and gneisses often carry pyrite, and occasional streaks and irregular masses are found that are quite rich. So far, however, no workable bodies have been discovered. Some of the magnetite deposits are pyritous and occasionally they are notably so, as is instanced in the Lee mine near Port Henry.

Elsewhere in the State, pyrite is quite widely distributed, though not usually found in quantity. The Phillips magnetite mine, Putnam co., is mentioned by Beck as affording the mineral. It is associated here with magnetite and also impregnates the walls. It constitutes from one half to one sixth of the ore body.

The pyrrhotite mine at Anthony's Nose, Westchester co. may be mentioned in this connection, as it has supplied material for sulfuric acid making. The deposit is of lenticular form, 20 to 30 feet thick, inclosed in acid gneiss. It was operated during the period from 1865 to 1875. The workings extend 50 feet or more on the strike and to a depth of 300 or 400 feet. The ore contains a small percentage of nickel.

The production of pyrite in 1901 amounted to 10,100 long tons, valued at $40,465. In the previous year the output was 5275 long tons, valued at $20,820. The supply was derived entirely from the mines in St Lawrence county.

Bibliography

Beck, Lewis C. Mineralogy of New York. 1842. p.387
Whitlock, H. P. N. Y. State Geol. 23d An. Rep't. 1904. p.180.

QUARTZ.

Quartz is obtained at present near Bedford, Westchester co. It belongs to the massive variety and occurs nearly pure in veins and mixed with feldspar and pegmatite. It varies from white to smoky gray, or more rarely has a reddish or rose color. The country rock is porphyritic gneiss. Ordinary quarry methods are employed in working the deposits. The product has been shipped largely to the potteries at Trenton, N. J. for use in making white earthenware and porcelain, but of late years a more important application has been the manufacture of wood filler and silicate paint. The Bridgeport Wood Finishing Co. of New Milford, Ct. is the largest producer.

Quartz veins are very common in the Adirondacks, where they are associated with gneisses and schists and sometimes attain large proportions. In the southeastern part from Fort Ann to Port Henry, there are a number of occurrences that have furnished material for wood filler, which at one time was manufactured near Fort Ann. For several years, however, no production has been made from this section.

SALT

Salt has long been one of the chief mineral products of the State. The New York industry commands extensive markets which has enabled it to maintain a position of commercial prominence notwithstanding the many new sources of supply that have been developed in recent years.

The salt deposits are associated with strata belonging to the Salina stage of the Upper Siluric. The beds comprise shales, lime-

stones, dolomites and gypsum, besides rock salt. The horizon of the latter has been definitely fixed in the series between the Vernon red and green shales and the Camillus gypsum and dolomite beds. A synopsis of the classification of the Salina stage, as now recognized by geologists, will be found under the subject of gypsum.

The occurrence of salt has been established over a large area. The northern limit, as shown by the outcropping Salina strata, is approximately defined by a line drawn from a point somewhat south of Oneida lake, westward to Buffalo. To the south of this line the deposits are encountered at progressively increasing depths in accordance with the dip of the strata which ranges up to 40 or 50 feet to the mile. The most easterly point where wells have been sunk is at Morrisville, Madison co. Between this locality and Lake Erie, salt has been found in almost all of the central tier of counties.

In Onondaga county, Syracuse continues to be an important center of the industry. The manufacture of salt began there in 1789 and in 1797 it came under State control. For a long time the wells yielded nearly all of the salt made in the State, but in late years there has been an increasing output from other localities. A noteworthy feature, also, has been the falling off in the production of the finer grades of salt. Almost the entire yield at present is of the solar or coarse variety. The largest operator in Onondaga county is the Solvay Process Co. The company derives its supply of brine from wells in the town of Tully, 20 miles south of Syracuse. The deposits are rock salt, and the brine is obtained by bringing fresh water into the wells. Formerly the brine was allowed to flow out under its own pressure, but owing to the loss from percolation with this method, the wells are now pumped. The brine is conveyed by pipe line to the works at Solvay, where it is used for the manufacture of soda products.

In Tompkins county a test well drilled at Ithaca in 1885 encountered seven beds of rock salt aggregating 248 feet in thickness at depths below 2244 feet from the surface. This discovery was followed by active developments at Ludlowville in 1891 by the Cayuga Lake Salt Co., and at Ithaca in 1895 by the Ithaca Salt Co. The plants were taken over in 1899 by the National Salt Co., which was merged last year into the International Salt Co. More recently the Remington Salt Co. has erected a plant near Ithaca, which is now under operation. The company has drilled three wells, finding the salt at about 2100 feet below the surface.

Salt is obtained in Schuyler county around Watkins. The Glen Salt Co. sank the first well in 1893 and encountered a deposit at a

depth of 1846 feet. The plant is now owned by the International Salt Co. The Watkins Salt Co. also operates at this locality.

The discovery of salt near Wyoming, Wyoming co., in 1878, furnished an incentive for the exploration of this region. The first well penetrated 70 feet of rock salt at 1270 feet from the surface. It was followed by discoveries at Warsaw, Leroy, Rock Glen, Batavia and numerous places in Livingston, Wyoming and Genesee counties. Practically the whole valley of Oatka creek, from Leroy to Bliss and the Genesee valley south of Monroe county have been found to be salt bearing. The region is now one of the most productive in the State. The International Salt Co. has operated three plants at Warsaw. The other active companies in this field are the Leroy Salt Co. of Leroy; the Genesee Salt Co. of Piffard; the Worcester Salt Co. of Silver Springs; and the Retsof Mining Co. of Retsof. The last named company produces rock salt. A large number of plants have been erected by other companies that are now inoperative.

In Erie county salt has been found at Eden Valley, Springville and Gowanda, but these localities are no longer productive. At Perry, the Iroquois Salt Co. has a plant which has been operated during the last few years.

Among other discoveries of salt in New York may be mentioned those at Vincent and Naples, Ontario co.; Dundee, Yates co.; Seneca Falls, Seneca co.; and Aurora, Cayuga co. The deposits are not worked.

All of the commercial grades of salt are made in New York, including coarse solar, common coarse, common fine, table and dairy, packers and rock salt. The coarse solar is produced around Syracuse where large tracts of land are given up to its manufacture. There are four rock salt mines in the State, but only that at Retsof is now operated.

Production. During the year 1905, there were 31 companies engaged in the production of salt within the State, as compared with 30 companies in the preceding year. Of the number reporting in 1905, Onondaga county was represented by 23 companies; Wyoming, Tompkins and Livingston counties by two each and Genesee and Schuyler counties by one each. The International Salt Co. is included under Tompkins county, but it also operated plants in Schuyler and Wyoming counties. The Genesee Salt Co., of Piffard, Livingston co., which was inactive during the previous year, reported an output in 1905.

The total output of salt for 1905 amounted to 8,575,649 barrels of 280 pounds, against 8,724,768 barrels in 1904, showing a decrease of 149,119 barrels. The totals for each year include the amount of salt utilized in the form of brine for the manufacture of soda products, which is a very large item. Notwithstanding the decreased production, it will be noted that the higher market prices prevailing in 1905 brought about a gain in the total value of $200,319.

Production of salt by grades in 1904

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine[a]	1 309 531	$409 498	$ .31
Common coarse	423 686	142 357	.33
Table and dairy	1 160 423	518 742	.45
Coarse solar	459 156	175 931	.38
Packers	46 178	14 180	.31
Other grades	5 325 794	842 040	.16
Total	8 724 768	$2 102 748	$ .24

[a] Includes a small quantity of coarse solar salt.

Production of salt by grades in 1905

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine[a]	1 355 843	$486 371	$ .36
Common coarse	238 149	93 567	.39
Table and dairy	1 169 229	684 239	.58
Coarse solar	453 206	173 729	.38
Packers	37 792	14 477	.38
Other grades	5 321 430	850 684	.16
Total	8 575 649	$2 303 067	$ .27

[a] Includes some coarse solar salt, though the amount is not important.

The accompanying tables show the production for the last two years distributed among the various grades as marketed. The output listed under "other grades" is made up principally of rock salt and salt used for soda manufacture, but includes small quantities for which the use is not specified in the returns.

Onondaga county ranks first among the counties of the State in salt production. In 1905 it contributed 3,140,644 barrels, valued

at $317,404, against 3,456,337 barrels, valued at $233,477, for the preceding year. The operations of the Solvay Process Co. account for most of the production. Since this company converts the brine directly into soda, the value placed upon the salt is much lower than that given for the marketable grades. In addition to this company there were 22 producers in the county, all of them operating in Syracuse and vicinity and marketing their product through the Onondaga Coarse Salt Association of that city.

The relative rank of the other counties contributing to the output was as follows, in the order of their importance: Livingston, Wyoming, Schuyler, Tompkins and Genesee.

The single rock salt mine which has been active was that at Retsof, Livingston co., owned by the Retsof Mining Co. of Scranton, Pa. The Oatka Mining Co., which has been engaged in opening a mine at Wyoming, has discontinued operations. A new company organized under the title of the Sterling Salt Mining Co. began development work during 1905 at Cuylerville, and intends to produce rock salt. At the close of the year the shaft had reached a depth of a little over 500 feet.

The International Salt Co., of New York city, operated the following plants in 1905: Glen Works, Watkins; Ithaca Works, Ithaca; Cayuga Works, Myers; Hawley and Yorkshire Works, Warsaw. The Warsaw Works at Warsaw was inactive. The International Salt Co. assumed control of the works mentioned on August 1, 1904, succeeding the National Salt Co. The company is also interested in the Retsof rock salt mine.

Bibliography

Beck, Lewis C. Mineral Springs. Mineralogy of New York. 1842.
Bishop, I. P. Salt Wells of Western New York. N. Y. State Geol. 5th An. Rep't. 1886.
—— Salt Industry of Central New York. N. Y. State Mus. 45th An. Rep't. 1892.
Hall, James. Geology of New York: Report on Fourth District. 1843.
Luther, D. D. Geology of the Livonia Salt Shaft. N. Y. State Geol. 13th An. Rep't. 1894.
—— Brine Springs and Salt Wells of New York and Geology of the Salt District. N. Y. State Geol. 16th An. Rep't. 1899.
Merrill, F. J. H. Salt and Gypsum Industries of New York. N. Y. State Mus. Bul. 11. 1893.
Vanuxem, L. Geology of New York: Report on Third District. 1842.

SAND

Sand is obtained in nearly every part of the State. Enormous quantities of building sand are consumed each year, and glass sand, molding sand and other varieties are produced on quite an extensive scale.

Building sand. The glacial deposits which are a prominent feature of the topography in many sections afford an abundant source of sand for building and construction purposes. Such sand may be mixed with gravel, boulders and clay, requiring some preparation by screening or washing before it can be used. Frequently, however, the materials have been sorted before deposition so that beds yielding quite clean and evenly sized sand may be worked. The supplies of sand used in building operations in Albany and Rochester are derived from local morainal deposits. Alluvial sand found along the stream valleys is employed in many localities in the interior of the State. Beach sand also enters into the trade; most of the sand consumed in New York city is obtained from the shores of Long Island, and Buffalo derives its supply from the beaches of Lake Erie, principally from the Canadian side.

While the trade in building sand has attained to very large proportions, it is difficult to secure reliable information on the subject, owing to the numerous small enterprises engaged in the industry and their somewhat unstable character. The value of building sand is mostly represented in the cost of excavation and transport to market.

Glass sand. For the manufacture of glass, pure quartz sand is required. The presence of dark minerals such as magnetite, hornblende, mica etc., which carry iron, is objectionable. In the manufacture of window glass and common glassware, the iron is kept down to a small fraction of 1 per cent, while for the finer grades no more than a trace is allowable.

The glass sand produced in the State comes from the vicinity of Oneida lake. The principal workings are in the towns of Rome, Verona and Vienna, Oneida co.; and Constantia, Oswego co. The deposits vary from 6 inches to 3 feet in thickness and are covered by a few inches of soil. The sand is prepared for market by washing in sheet iron sieves and subsequent stirring in troughs partly filled with water. It is shipped to various points including Rochester, Ithaca, Lockport, Black Rock, Syracuse and Clyde. The resources of this section early attracted attention and for many years the manufacture of window glass by local plants was a flourishing industry. The business has declined in importance owing to competition with manufacturing centers situated in the coal and natural gas fields. An analysis of glass sand from West Vienna, furnished by B. Delahunt, manager of the Oneida Lake Sand Mine, shows the following chemical composition.

Silica (SiO_2)	98.6
Alumina (Al_2O_3)	.23
Ferric oxid (Fe_2O_3)	.17
Magnesia (MgO)	trace
	99.00

The output of glass sand in 1905 amounted to 9850 short tons valued at $7765, reported by four producers. In the preceding year three companies reported a total of 11,080 short tons, valued at $8484.

At one time considerable quantities of glass material were obtained near Ellenville, Ulster co. The Shawangunk grit, a nearly pure quartz conglomerate, was quarried, ground and shipped to glass companies in Pennsylvania. The Potsdam sandstone has also been used for glass making.

Molding sand. Molding sand of excellent quality is found in the Hudson river valley. A large part of the requirements of foundries in the eastern United States is furnished from this section. The molding sand occurs in beds of varying thickness underlying the soil and resting upon coarser sand or upon clay. In some cases it outcrops at the surface, the usual covering having been removed by erosion. The method of digging the sand is described by F. L. Nason, as follows:

In gathering the sand for market a section of land 1 or 2 rods in width is stripped of its overlying soil and down to the sand. The sand is then dug up and carted away from this strip. After the sand is moved from the first strip, a second belt is cleared of soil and dumped on the first and so on until the whole field has been stripped of its sand. After stripping the entire field the soil is replaced and leveled down and is then just as good for agricultural purposes as before.

It is estimated that 6 inches of sand will yield 1000 tons an acre. The owner of the land receives on the average about $2.50 an acre as royalty for removing the deposit.

In Albany county the finest grades of molding sand, adapted for stove and other castings that require a smooth finish, are obtained at Delmar and Selkirk. The output is shipped to Albany, Troy and more distant points, bearing a freight rate as high as $3 a ton. Deposits are also worked near Coxsackie Station, Columbia co. and near Camelot and New Hamburg, Dutchess co.

SLATE

Quarries of roofing slate are worked in Washington county near the Vermont state line. The productive district includes a narrow belt running nearly due north from Salem through the towns of Hebron, Granville, Hampton and Whitehall. Efforts have been made to work slate in other parts of the State, particularly in the Hudson river metamorphic region, but for reasons no longer apparent they have not led to the establishment of a permanent industry. Hoosick, Rensselaer co., New Lebanon, Columbia co., and New Hamburg, Dutchess co., are among the places that have furnished slate in the past. At the locality last named, beds were found which yielded large blocks resembling the Welsh slate in color and quality and adapted for structural material, billiard tables, blackboards and other purposes. They were operated as late as 1898.

The slate from Washington county exhibits a variety of colors. Red is the most valuable and is the characteristic product of the region. Owing to its rarity elsewhere, it has a wide sale and is in constant demand for export. This variety is found near Granville and in the Hatch Hill and North Granville districts between North Granville and Whitehall. Its occurrence is confined to areas of Lower Siluric age. Purple, variegated and different shades of green slate are produced from Cambric areas, principally around Middle Granville, Salem and Shushan. The unfading green, which likewise commands a good price for roofing purposes, is quarried to some extent in Washington county, but the greater quantity comes from across the border in Vermont.

Up to the present time the production of slate for other than roofing purposes, such as mantels, billiard tables, floor tiling, blackboards etc., has not been developed to any extent in this section. It is an important branch of the slate trade of Pennsylvania and Vermont, and there is no doubt that increased attention to this branch would greatly assist the advancement of the industry.

Production. The reports received for 1905 show that 10 firms were engaged in quarrying slate during the year. The total output was 16,460 squares of roofing slate, valued at $94,009; and $1000 of mill stock. In 1904 the roofing slate amounted to 18,090 squares, valued at $86,159, and the mill stock at $7441. The average value of the roofing slate was $5.71 a square in 1905 and $4.76 a square in the preceding year. The prices are above those received in other slate-producing regions.

A new quarry was opened at Salem by William Blanchfield, and a small quantity of roofing slate was taken out as a test. The Wil-

liams Slate Co., which formerly operated quarries at Middle Granville, has retired from business.

Bibliography

Dale, T. N. The Slate Belt of Eastern New York and Western Vermont. U. S. Geol. Sur. 19th An. Rep't. pt 3. 1899.
Mather, W. W. Geology of New York. Report on First District. 1838.
Nevius, J. N. Roofing Slate Quarries of Washington County. N. Y. State Geol. 19th An. Rep't. 1901.
Smock, J. C. Building Stones in New York. N. Y. State Mus. Bul. 10. 1890.

STONE

All of the principal building and ornamental stones are quarried in New York and most of them on a large scale. In the following pages a brief description is given of their occurrence throughout the State, together with information relating to production and recent developments. The slate, marl and millstone industries, which might properly be included here, have been treated under separate headings owing to their somewhat special character.

Production of stone

The value of the quarry products for 1905 amounted in the aggregate to $6,107,147. The value of the limestone quarried was $2,411,456. The sandstone was valued at $2,043,960, the greater part reported by companies engaged in the bluestone trade. The output of trap, mostly from the Hudson river Palisades, was valued at $623,219. Marble accounted for a value of $774,557. The value of the granite produced was $253,955. Classified as to uses, building stone was one of the leading items in the production with an aggregate value of $1,488,009. It was exceeded only by the value of crushed stone which aggregated $1,902,623. Curb and flagstones amounted to the sum of $1,037,210, represented almost entirely by bluestone. The monumental stone, principally marble, was valued at $187,988. The value of the stone quarried for purposes other than those given, including lime, furnace flux, paving blocks, rubble etc. was $1,491,317.

A comparison of the above totals with the corresponding figures for 1904 shows that there was a large expansion in the quarrying industry last year which was shared by all branches. The aggregate increase amounted to $937,206, or about 18 per cent. This was distributed along the different varieties of stone as follows: limestone, $307,361; sandstone, $147,263; marble, $295,786; granite, $32,073; and trap $154,723.

The rapidly extending use of crushed stone for concrete, road metal, etc. is one of the important factors in the development of the quarry industry of the State. The quantity of crushed stone made last year was 2,762,774 cubic yards, as compared with 2,224,000 cubic yards in 1904. The quantities reported as used for road metal were 1,080,034 cubic yards in 1905 against 773,553 cubic yards in the preceding year.

Production of stone in 1904

Variety	Building stone	Monumental	Curbing and flagging	Crushed stone	All other	Total value
Granite	$89 300	$11 262	*a*	$83 295	$38 025	$221 882
Limestone	248 647	.....	$6 253	994 475	809 030	2 104 095
Marble	278 994	154 673	*a*	*a*	45 104	478 771
Sandstone	637 607	.....	902 027	27 583	329 480	1 896 697
Trap	*a*	.....	.....	452 621	15 875	468 496
Total	$1 254 548	$165 935	$908 280	$1 557 974	$1 237 504	$5 169 941

a Included under "All other"

Production of stone in 1905

Variety	Building stone	Monumental	Curbing and flagging	Crushed stone	All other	Total value
Granite	$139 414	$10 431	*a*	$69 748	$34 362	$253 955
Limestone	246 300	.....	$7 297	1 193 800	964 059	2 411 456
Marble	571 810	177 557	*a*	*a*	25 190	774 557
Sandstone	530 485	.....	1 029 913	37 406	446 156	2 043 960
Trap	*a*	.....	.....	601 669	21 550	623 219
Total	$1 488 009	$187 988	$1 037 210	$1 902 623	$1 491 317	$6 107 147

a Included under "All other."

Granite

The term granite, as here used, includes the crystalline rocks generally, with the exception of trap or diabase which is treated by itself.

There are two principal areas where these rocks occur in New York, the one being the Adirondack region and the other the lower Hudson valley. Massive granites are much less important in both areas than the banded or schistose types designated as gneisses and schists; they are sufficiently developed, however, to afford frequent sites for quarries. At present most of the granite employed for building, monumental and decorative purposes is brought in from other states, as the local production is far from meeting the requirements.

In southeastern New York, the Highlands of the Hudson consist almost entirely of granite and gneiss. Quarries have been opened at numerous localities, particularly along the river where convenient transport facilities can be had. In Putnam county, Breakneck mountain, just north of Cold Spring, supplies a medium grained grayish gneissoid granite which has been used extensively for building material and crushed stone. At Garrisons a true granite of massive character outcrops and has furnished building stone to New York city. Farther south around Peekskill there are several quarries producing gneissoid granite.

In Westchester county granitic rocks are abundant and of varied character. One of the principal formations is the Fordham gneiss, a well foliated grayish biotite gneiss that has supplied much material for foundations and rough masonry. The quarry localities include Hastings, Lowerre, Bryn Mawr and Uniontown. The Yonkers gneiss, more massive than the former and containing hornblende, affords a durable building stone which is obtained at Dunwoodie and Scarsdale, while a similar rock occurs at Hartsdale, Hastings, Tarrytown and White Plains. Dikes and bosses of massive granite are quite common and have been worked at New Rochelle, Mount Vernon, Lake Mohegan, Westchester co.; Round Island, Rockland co.; and at Pine Island, Orange co. The last named locality affords a coarse hornblende granite much used as a dimension stone. The Cortland series of gabbros and diorites outcropping south of Peekskill may be mentioned among the quarry resources of this region.

The crystalline rocks of the Adirondacks extend over a great area, but their inaccessibility has prevented the opening of quarries, except on the borders. The varieties found here include massive granites, syenites, gabbros and anorthosites, as well as gneissoid phases of each.

Building and monumental stone is quarried largely in Jefferson county. Grindstone island, in the St Lawrence river, is noteworthy as a locality for red granite of very attractive appearance. The latter has a coarsely crystalline texture, takes a lustrous polish, and on account of its deep red color has been employed as a substitute for Scotch granite. It is used for building, monumental and decorative purposes in many of the western cities and in Canada.

At Little Falls, Herkimer co., there is an outlet of Adirondack syenite which is worked to some extent. It is a closely textured rock, well adapted for all construction work. In Fulton county

quarries have been opened at Mayfield and Northville, in Lewis county near Port Leyden and in Franklin county at St Regis Falls.

Anorthosite has been quarried near Keeseville, Essex co., and at West Chazy, Clinton co. The stone has a handsome chatoyant appearance when polished, and is adapted for monumental and decorative work.

Production of granite

Material	1904	1905
Building stone	$89 300	$139 414
Monumental	11 262	10 431
Crushed stone	30 295	69 748
Rubble, riprap	83 760	30 125
Other kinds	7 265	4 237
Total	$221 882	$253 955

The aggregate value of the products of the granite quarries in the State amounted last year to $253,955. Building stone was the largest item in the production, with a total valued at $139,414. Among the other kinds represented with their values were: crushed stone, $69,748; rubble and riprap, $30,125; monumental stone, $10,431; paving blocks, curbing and miscellaneous, $4237. The quantity of crushed stone reported was 87,655 cubic yards. Westchester county alone made an output valued at $142,815, consisting principally of building stone, crushed stone and rubble. The remainder of the production was distributed among the following counties: Clinton, Essex, Fulton, Herkimer, Jefferson, Lewis, Orange, Putnam, Rockland and Warren.

In 1904, Westchester county reported a value of $125,150; Orange and Rockland counties, $83,520; Jefferson, $8412; and Fulton, $4800.

Limestone

The limestone quarries are the most important in New York State. Compared with sandstone, which ranks second in value of output, limestone is not specially prominent as a building material, but it is more generally used for road metal and concrete. Its wide occurrence, in connection with its natural fitness for the purpose, has favored the development of an extensive crushed stone trade that covers nearly every section of the State. The manufacture of lime also calls for a large part of the product.

Among the geologic formations of the New York series, limestone appears frequently. In the Precambric strata of the Adirondacks

and in southeastern New York it has been metamorphosed and has the crystalline character of marble. The noncrystalline limestones, to which the present discussion is limited, are associated with the Lower Siluric, Upper Siluric, and Devonic systems. Those chiefly exploited will be briefly described.

Beekmantown limestone. The Beekmantown limestone or calciferous sandrock, as it has been commonly called, occurs in isolated areas along the Mohawk and Champlain valleys. There are quarries in Warren, Montgomery, Fulton and Herkimer counties. It is a fine grained, massive stone of grayish color and normally contains more or less magnesia. This constituent sometimes occurs in sufficient amount to characterize the rock as dolomite. Owing to its prevailing silicious nature, the limestone can seldom be used for other than building purposes.

Chazy limestone. The Chazy limestone is of local importance. It is found along a narrow belt bordering the Adirondacks from Saratoga county north to Clinton county. It attains its greatest development in the eastern and northern parts of Clinton county. In composition it is a typical limestone, containing little magnesia or impurities. For this reason it is adapted to the manufacture of lime. The stone has a finely crystalline texture, and at Chazy and Plattsburg has been quarried for marble. It supplies also some building stone and furnace flux.

Trenton group. In the Mohawkian or Trenton group are included the Lowville (Birdseye), Black River and Trenton limestones, which occupy a large area and possess considerable economic value. They occur in the Champlain valley, but mostly on the Vermont side, and on the southern and western borders of the Adirondacks. From the Mohawk valley at Little Falls they form a belt that extends northwesterly with gradually increasing width to the St Lawrence river. The area on the eastern side of Lake Champlain is continued southward into Washington county. The limestone varies somewhat in character according to locality and geologic position. It is often highly fossiliferous. The lower part of the group or Lowville formation is a heavy bedded limestone, but the upper beds commonly contain more or less shale. The color ranges from light gray to almost black. It sometimes shows incipient metamorphism and has a crystalline texture. The Trenton limestones are quarried in Clinton, Washington, Montgomery, Fulton, Herkimer, Oneida, Lewis and Jefferson counties. The product is used for building and road material and common masonry. A part is also burned into lime. At Glens Falls, Trenton limestone is employed for the manufacture of Portland cement.

Niagaran group. The next group of limestones in ascending order is the Niagaran, which comprises the Lockport and Guelph formations. The latter is a typical dolomite, fine grained and of grayish color. It occupies a limited area in Monroe and Orleans counties, and is quarried near Rochester. It has been used for lime. The lower member of the group, the Lockport dolomite, outcrops in a continuous belt several miles wide from Niagara Falls east to Onondaga county, and then with diminishing width across Madison county. Like the Guelph it contains magnesia, and this component may be present in sufficient quantity to make it a dolomite. The lower part is usually silicious, grading into shale. The upper portion which is heavy bedded is adapted for building material, road metal, lime, etc. There are quarries around Niagara Falls and Lockport. It is also worked at Rochester and to some extent in Wayne, Onondaga and Madison counties.

Cayugan group. The Cayugan group with its members is noteworthy economically, as it contains the valuable gypsum and salt deposits besides the hydraulic limestones that are utilized for cement. The basal strata, comprising the Salina stage, are mostly shales, though they interbedded with thin layers of dolomitic limestones. In the Cobleskill, Rondout and Manlius stages, limestones prevail. In the Rosendale district of Ulster county they have furnished large quantities of material for the manufacture of natural rock cement, and they are the source of the cement rock in Onondaga and Schoharie counties. The purer limestones of the group are employed in Onondaga county for lime making.

Helderbergian group. At the base of the Devonic system, the Helderbergian group is prominent for its limestones. The latter are strongly developed along the Hudson river in Albany, Columbia, Greene and Ulster counties. The Coeymans or Lower Pentamerus formation affords rock suitable for lime, building stone and road material, while the Becraft or Upper Pentamerus is employed as an ingredient of Portland cement and for furnace flux. There are quarries at Hudson, Rondout, South Bethlehem and Catskill.

Onondaga limestone. Of the remaining formations represented in New York, the Onondaga is the only one that is of much importance for limestone quarries. It outcrops in Orange, Ulster, Greene and Albany counties, and is exposed quite continuously through the middle and western part of the State. Building stone and lime are the principal products. Quarries have been opened at Kingston, Split Rock (near Syracuse), Auburn, Waterloo, Seneca Falls, Leroy, Buffalo, and many other places.

Production of limestone

Limestone is quarried in 35 counties of the State with a total of about 160 active quarries. The value of the production last year amounted to $2,411,456. This is exclusive of the limestone used in the manufacture of Portland and natural cement, for which no statistics have been collected. Compared with the preceding year, there was a gain of $307,361 in the production.

Production of limestone

MATERIAL	1904	1905
Crushed stone	$994 475	$1 193 800
Lime made	678 225	702 684
Building stone	248 647	246 300
Furnace flux	121 109	198 168
Rubble, riprap	22 230	40 664
Flagging, curbing	6 253	7 297
Miscellaneous	33 156	22 543
Total	$2 104 095	$2 411 456

Crushed stone for road metal, railroad ballast, concrete and other uses, represents the largest item in the output. The value of this material was $1,193,800, against $994,475 for 1904. The manufacture of lime is second in importance with a product valued at $702,684 and $678,225 for the respective years. The building stone quarried amounted in value to $246,300, against $248,647 in 1904; furnace flux to $198,168, against $121,109; rubble and riprap to $40,664, against $22,230; flagging and curbing to $7297, against $6253; and miscellaneous materials, not classified in the returns, to $22,543, against $33,156 in the preceding year.

Distributed according to the counties in which the limestone was quarried, the largest producer last year was Erie county which had an output valued at $383,411, consisting principally of building stone, crushed stone and furnace flux. Onondaga county which was first in 1904 ranked second last year with an aggregate of $310,322, mainly represented by lime manufacture. The remaining counties which reported a total value of over $100,000 each were Dutchess, $234,578; Genesee, $227,087; Rockland, $220,596; Warren, $192,136 and Albany, $101,425.

Lime. There were 41 firms that reported an output, last year, of limestone (including marble) for lime burning, either as a main product or in connection with the quarrying of other materials,

The greater portion of the limestone was converted by the companies operating the quarries. In all 21 counties participated in the production. The quantity of lime made was 323,905 short tons, valued at $702,684. Of the total, Onondaga county contributed 193,506 tons, or about 60 per cent. In the previous year the production amounted to 381,974 short tons, valued at $678,225, of which Onondaga county made 230,194 tons. The importance of the industry in this county is due to the operations of the Solvay Process Co., which uses the output as a reagent in the manufacture of soda products.

The production in the other leading counties was as follows, the figures for 1904 being given in brackets: Warren county, 38,025 [32,000] tons; Westchester, 24,700 [28,000]; Jefferson, 19,017 [17,403]; Clinton, 16,000 [15,873] and Washington county, 12,000 [9000] tons.

It will be noted that the value of the production as given above is considerably less than the ruling commercial price owing to the fact that a nominal valuation has been placed upon the portion used as a chemical reagent. Disregarding the quantities thus consumed, the value of the lime averaged $3.58 a short ton in 1905 and $3.54 a short ton in the preceding year.

Crushed stone. Limestone is more widely employed for crushing than any other kind of stone. The total production in 1905 amounted to 1,851,008 cubic yards valued at $1,193,800, as compared with 1,471,305 cubic yards valued at $994,475 in the preceding year. Of the quantities given, 573,924 cubic yards in 1905 and 443,037 cubic yards in 1904 were reported as having been used for road metal, though the actual amount thus used probably somewhat exceeded these totals. The leading counties in the production of crushed stone with their output are as follows, the figures for 1904 being bracketed: Rockland, 335,714 cubic yards [258,873]; Dutchess, 335,112 [320,701]; Genesee, 288,000 [252,224]; Erie, 243,628 [286,658]; Albany, 131,000 [80,503] and Onondaga, 84,811 [61,552].

Building stone. The production of building stone showed little change during the past year, the total value aggregating $246,300 against $248,647 in 1904. Erie county contributed the largest amount in both years, $103,763 in 1905 and $108,411 in 1904. With the exception of Schoharie county which had an output valued at $49,227, the remaining counties were small producers. There is a very large demand for limestone in building operations, but the greater part of the supply is brought in from other states.

Furnace flux. The metallurgical industries of the State are consumers of limestone which is employed as a flux in smelting operations. The largest users are the iron blast furnaces located in Buffalo and vicinity. The supply for this district is obtained from the Onondaga limestone in western New York and in the adjacent part of the province of Ontario. The principal New York quarries are located at Clarence and Gunnville, Erie co. and at North Leroy, Genesee co. The total production in 1905 amounted to 393,667 long tons, valued at $198,168. In the preceding year, the amount was 220,198 long tons, valued at $121,109. A quarry has been opened near Gouverneur, St Lawrence co., for the purpose of supplying furnace flux.

Production of limestone by counties in 1904

COUNTY	Crushed stone	Lime made	Furnace flux	Building stone	Other uses	Total
Albany	$47 872	$1 125	.....	$700	$500	$50 197
Cayuga	13 864	80	$1 000	12 432	16 500	43 876
Clinton	10 666	55 175	4 019	1 950	2 750	74 560
Dutchess	194 755	.....	.....	187	.....	194 942
Erie	170 509	400	46 299	108 411	15 793	341 412
Fulton	6 840	1 500	.....	.....	.....	8 340
Genesee	150 210	4 500	64 299	3 500	193	222 702
Herkimer	150	8 582	.....	500	.....	9 232
Jefferson	7 570	60 580	.....	20 096	6 106	94 352
Madison	7 595	.....	.....	125	3 000	10 720
Monroe	27 035	.....	.....	6 050	2 000	35 085
Montgomery	81	.....	.....	7 022	1 000	8 103
Niagara	15 727	4 500	.....	6 300	3 875	30 402
Oneida	16 387	.....	.....	1 500	.....	17 887
Onondaga	41 481	275 923	2 525	22 333	2 555	344 817
Rockland	194 154	.....	.....	.....	.....	194 154
St Lawrence	2 600	8 100	.....	2 924	3 350	16 974
Saratoga	33 151	.....	.....	1 500	.....	34 651
Schoharie	13 181	312	24	24 495	2 780	40 792
Ulster	9 317	2 620	.....	.....	.....	11 937
Warren	442	131 800	.....	17 813	.....	150 055
Washington	10 110	36 000	.....	.....	.....	46 110
Westchester	.....	72 800	800	.....	.....	73 600
Other counties[a]	20 778	14 228	2 143	10 809	1 237	49 195
Total	$994 475	$678 225	$121 109	$248 647	$61 639	$2 104 095

a Includes Allegany, Columbia, Essex, Greene, Lewis, Ontario, Orange, Orleans, Rensselaer, Seneca, Wayne and Yates.

Production of limestone by counties in 1905

COUNTY	Crushed stone	Lime made	Furnace flux	Building stone	Other uses	Total
Albany	$90 800	$9 600	.....	$525	$500	$101 425
Cayuga	13 227	.....	$240	9 650	11 500	34 617
Clinton	4 600	58 000	5 200	9 105	.....	76 905
Dutchess	234 578	.....	.....	.....	.....	234 578
Erie	153 736	497	96 626	103 763	28 789	383 411
Fulton	4 552	11 796	.....	.....	.....	16 348
Genesee	127 000	13 260	81 516	2 211	3 100	227 087
Herkimer	5 412	5 913	.....	30	1 020	12 375
Jefferson	3 951	71 106	.....	6 154	4 650	85 861
Madison	38 109	.....	.....	5 259	622	43 990
Monroe	37 404	.....	.....	8 036	351	45 791
Montgomery	60 385	.....	115	7 216	.....	67 716
Niagara	10 949	4 500	.....	3 055	.....	18 504
Oneida	17 243	.....	.....	1 500	.....	18 743
Onondaga	39 832	234 308	5 550	17 984	12 648	310 322
Rockland	220 596	.....	.....	.....	.....	220 596
St Lawrence	940	9 650	.....	2 249	3 185	16 024
Saratoga	8 500	.....	.....	3 065	205	11 770
Schoharie	17 246	.....	50	49 227	272	66 795
Seneca	2 330	360	37	3 918	368	7 013
Warren	9 463	171 556	.....	10 540	577	192 136
Washington	39 312	51 000	.....	175	.....	90 487
Westchester	30 748	43 900	300	.....	.....	74 948
Other counties[a]	22 887	17 238	8 534	2 638	2 717	54 014
Total	$1 193 800	$702 684	$198 168	$246 300	$70 504	$2 411 456

a Includes Columbia, Essex, Greene, Lewis, Ontario, Orange, Orleans, Rensselaer, Schenectady, Ulster, Wayne and Yates.

Marble

The granular crystalline limestones and dolomites which are classed as marble occur on the borders of the Adirondacks and in the region of metamorphic strata in southeastern New York. A few varieties of compact limestones that possess ornamental qualities are also included under this head, since they pass for marble in the trade.

Along Lake Champlain there are many localities where quarries have been opened at different times, but only a few are now operated. The Lepanto and French gray marbles are among the best known varieties from this section. They are obtained from Champlainic strata in the vicinity of Plattsburg and Chazy. The former is a variegated partly crystalline limestone with pink and white fossils inclosed in a fine grained ground mass. The French gray has a similar composition, though its color is more uniformly gray. Both

have been widely used for ornamental purposes such as tiling, mantels, table tops and general decorative work.

At Moriah and Port Henry, in Essex county, a serpentinous marble or verd-antique occurs as bands interfolded with gneiss. It consists of granular calcite and dolomite, giving a white ground in which the green mottlings of serpentine are very conspicuous. It is reported that blocks free from checks and joints and of good size are obtainable, but the frequent occurrence of sulfids has been a serious drawback to the use of the stone. There are no quarries now in operation. A similar marble in the town of Thurman, Warren co., is described by G. P. Merrill as composed of " about equal parts snow-white calcite and light yellowish green serpentine flecks and patches from $\frac{1}{16}$ to $\frac{1}{4}$ inch in diameter." The most extensive area of serpentinous marble in the State, probably, is that outcropping in the towns of Gouverneur, Fowler and Edwards, in St Lawrence county. A beautiful massive serpentine is found near Keeseville. It has a homogeneous body of rich green color, clouded and veined by red iron ore, with occasional black markings due to magnetite. Though somewhat broken by joints in the outcrop, masses of suitable size for decorative work could probably be obtained without much difficulty.

At Glens Falls a fine quality of black marble has been quarried for many years. It occurs as a stratum about 12 feet thick, overlain by thinly bedded gray limestones and slate. It has a compact even texture, the polished surface being a lustrous black. The stone has been shipped to all parts of the country, chiefly for tiling and ornamental work.

The Gouverneur quarries are among the most productive in the State. They afford an excellent monumental and building stone. The principal variety is dark bluish gray and coarsely crystalline, in appearance not unlike some granites. Lighter varieties grading into pure white also occur. In composition the marble is a quite pure calcium carbonate, with small amounts of silica, magnesia, iron and alumina. The beds, or veins as they are locally known, are associated with laminated gneisses, the whole forming a series of metamorphosed sediments classified by Dr Smyth as the Oswegatchie, which may be correlated with the Grenville series of Canada. The beds are steeply inclined and are followed down from the outcrop. Though the occurrence is extensive, only a portion of the area contains material that is sufficiently free from impurities or is otherwise adapted for use. Still the resources are known to be

large. The quarries are situated a short distance south and east of Gouverneur. They are equipped with mills, and practically all of the product is marketed as dressed stone. The value of the stone varies according to color and uniformity of appearance. The dark grades which are most sought for in monumental and decorative work bring as much as $4 a cubic foot. One quarry has made a specialty of supplying building stone for which a lighter and less pure material is used. The marble has an excellent reputation for durability. It takes a glossy polish and owing to the strong contrast between polished and chiselled surfaces it is well suited for the display of letters or designs.

The marbles of southeastern New York occur in belts of metamorphosed Precambric and Siluric strata on the east side of the Hudson river. One belt is exposed on Manhattan island and has been worked at Kingsbridge. The quarries at Tuckahoe and Pleasantville, Westchester co., have supplied white and gray marbles for building purposes and to a lesser extent for monumental work. The Tuckahoe marble is a coarse white dolomite; it has been employed in many notable structures in New York city. At Pleasantville the marble is an impure dolomite, with layers resembling that at Tuckahoe. It has a very course texture and is known as " snowflake " marble. The best grade has been obtained from a band about 100 feet wide. A large quarry at South Dover, Dutchess co., furnishes a similar white building marble of uniform quality. Among other localities where quarries have been opened in this section are Ossining, Dobbs Ferry, White Plains and Oscawana, in Westchester co., and Greenport in Columbia co. At Ossining, Pleasantville and Tuckahoe the stone has been used for making lime.

Production of marble

VARIETY	1904	1905
Building marble	$279 994	$571 810
Monumental	154 673	177 557
Other kinds	45 104	25 190
Total	$478 771	$774 557

The quarrying of marble was carried on during the past year in Clinton, Essex, Warren, St Lawrence, Columbia, Dutchess and

Westchester counties. The aggregate value of the output reported by 14 producers amounted to $774,557, divided as follows: building marble, rough and dressed, $571,810; monumental, rough and dressed, $177,557; other kinds, $25,190. Most of the marble used for building purposes came from southeastern New York, the output of this region being valued at $464,247. The remainder was supplied from Plattsburg and Gouverneur. St Lawrence county reported a total production valued at $265,722, of which $173,557 represented the value of monumental marble.

The production for 1905 was probably the largest ever made in the State. It exceeded that of the previous year by over 60 per cent.

Sandstone

BY C. A. HARTNAGEL

Sandstones include the sedimentary rocks which consist of grains of sand bound together by some cementing material. The sand grains are derived from preexisting rocks, either igneous or sedimentary, and represent the more resistant constituents that were left in the form of sand when the rocks underwent disintegration through the various agencies of weathering and erosion.

The form or shape of the grains may be angular, as in the river-derived sands, or they may be more or less rounded, as is the case with wind-blown sands and those which before deposition and consolidation have been rolled about by wave action. The texture of sandstones may be fine, medium or coarse, depending upon the size of the grains, which ranges from dustlike particles up to pebbles an inch or more in diameter. Every gradation may be observed from the finest sandstones to the coarse, pebbly varieties known as conglomerate. The size of the grains may vary considerably within the limits of a hand specimen, according to the degree the materials have been sorted by water and the action of the wind in bringing in finer particles from the surrounding land.

While quartz is the principal component which goes to make up sandstones, yet grains of one or more other minerals may be present in greater or less abundance. The more common accompaniments include feldspar, mica, calcite, marcasite, pyrite, magnetite, glauconite and zircon. A variety of sandstone known as arkose has approximately the same composition as granite, from which it has been derived by disintegration and later consolidation of the materials. If in a sandstone any of the above minerals predominate, so

as to give a special character to the grains, we speak of this feature according to the prevailing mineral, as feldspathic, calcareous, micaceous etc. According to the principal cementing material sandstones may be designated as silicious when the cementing material is silica, calcareous when it is calcite, ferruginous when it is an oxid of iron, and argillaceous when the cement is some form of clay.

In chemical analysis the grains and cementing material are usually treated as a whole; the estimation of silica for example includes the amount of quartz present in both these forms, as well as the silica found in the feldspar and any other minerals which the rock may contain. Accordingly the analysis does not always show the true amount of free silica or quartz present, but this may be obtained by recasting the analysis.

In color sandstones are to a greater degree dependent on the character of the cementing material than on that of the grains. The color may range from a nearly pure white, in rocks where the cementing material is silica, to various shades of red, brown, olive-green, purple etc. The greatest range of color is afforded by those with ferruginous cements. Permanency of color is also affected by the nature of the cementing material. Those compounds in which iron is present in the higher stage of oxidation are more durable than compounds with the lower or ferrous oxid.

The weight of a certain volume of sandstone is dependent upon the character of the minerals composing the rock and the state of aggregation of the component parts. If the space between the grain is well filled with cementing material, the rock will be more dense in proportion to the amount of pore space filled. The apparent weight of the stone is increased by the amount of water absorbed, which in volume is from one third to one half of the total amount of pore space. A dense quartzite may weigh as much as 170 pounds a cubic foot, giving the rock a specific gravity above pure silica. The average range in weight of sandstones is 135 to 165 pounds a cubic foot.

The distribution of sandstones in New York, with a brief description of their character, economic value, etc. is given herewith.

Potsdam sandstone. This sandstone belongs to the Upper Cambric and is the lowest formation which is utilized in New York State for building purposes. The most extensive outcrops of the Potsdam are along the northwestern and northern border of the Adirondacks, in Jefferson, St Lawrence, Franklin and Clinton counties. Other important outcrops though of much less area than the above are found along the eastern and southeastern border of the Adiron-

dacks. These latter areas are included in a region that has been greatly disturbed, so that the outcrops are not continuous, but are often abruptly terminated by fault lines. Several inlying areas of Potsdam sandstone are also found well within the crystalline area.

Quarries in Potsdam formation have been opened at Clayton, Chippewa Bay, Hammond, Redwood, Potsdam, Malone, Bangor, Moira, Keeseville, Port Henry, Whitehall, Fort Ann and several other localities.

At present the principal quarries are those of the Potsdam Red Sandstone Co. These quarries are located at the type section of the Potsdam formation, along the Raquette river, 3 miles south of Potsdam.

The Potsdam sandstone combines great strength and low absorptive powers and is thus admirably suited for structural and street work. The rock is typically a hard even grained stone, composed almost wholly of quartz, the component grains being cemented by a secondary deposition of quartz, thus approaching closely to a quartzite. There is enough oxid of iron to give it a reddish color, though in some localities the iron is absent and the rock is nearly a pure white. The Potsdam sandstone has sustained a crushing test of more than 42,000 pounds.

Hudson River group. This group consists of a great series of sandstones, shales and slates and some conglomerates. The rocks of this group are separated from the Potsdam by the Lower Siluric limestones. The term as here used is an old one and includes beds which range in age from the Middle Trenton to and including the Lorraine beds. As the formations of this group have as yet not been delineated on the map, the group is retained in its former areal significance.

In southern New York, these rocks are first seen in Orange county, and form about two thirds of the entire area of the county. From here they extend north on both sides of the Hudson river. From Kingston north nearly to Albany they form a narrow belt on the west side of the river, while on the east side they cover a considerably larger area. North from Albany, they are found on both sides of the Hudson as far as Glens Falls and still farther east they extend to the Champlain valley. The greatest expansion of this group is found in the region north from Albany and west of the Hudson. Large portions of Albany and Saratoga and nearly all of Schenectady and Montgomery counties are in this formation. Farther west, except where are southern projections of the crystalline area, the group extends on both sides of the Mohawk to

Rome. From here the group extends northwest into Lewis and Jefferson counties and then again southwest into Oswego county where the formation terminates at the east end of Lake Ontario.

The strata of this group consist of fine grained grayish sandstone. They occur in even layers and most of the quarries show well defined jointed structure. To the east of Schenectady county, the rocks of this group are often involved in a complex series of folds and faults, but to the west of the county, folds are not important and the rocks of this group have a dip to the south which, however, is modified by the presence of several fault planes. The great extent of the group, the comparative ease with which the stone may be quarried and the exceptional transportation facilities have resulted in the opening of a large number of quarries. Most of the quarries produce stone for local use only, while the larger quarries produce stone mainly for rubble and common masonry work. At present none of the large quarries are in steady operation.

Medina sandstone. The Medina formation occupies a belt averaging nearly 10 miles wide, which extends along the southern shore of Lake Ontario and projects into the Mohawk valley, where the formation is represented by coarse beds of sedimentation representing the upper portion of the Medina and known in this section of the State as the Oneida conglomerate. The conglomerate is coarsest at the base and becomes more like the typical Medina sandstone with diagonal laminations as we pass higher in the formation. In this section of the State, the passage of this formation into the Clinton appears to be gradual and the division line between the two formations has been as yet not clearly drawn. There are quarries in the Oneida conglomerate which produce stone for local use.

In western New York, the Medina formation is 1200 feet thick. All the quarries which are operated between the Niagara and the Genesee rivers are in the upper 150 feet of the formation, and usually but a short distance north from the Niagaran escarpment.

The quarries operated in western New York are mostly in Orleans county. The other quarries outside of this county are at Lockport and Lewiston in Niagara county and at Brockport and Rochester in Monroe county. In Orleans county, most of the quarries are located near the banks of the Erie canal. This, together with the nearness of the railroad, offers excellent shipping facilities. Some of the quarries have the advantage of being located between the canal and the railroad and practically occupy all the space between them.

East from Rochester and extending through Wayne county, the Medina outcrops as a narrow belt along the lake shore. The formation widens again before Oswego county is reached and quarries have been opened in the red sandstone at Oswego and at the city of Fulton. Along the lake shore, the gray Oswego sandstone outcrops. This gray sandstone is usually considered a basal Medina. It is quarried to some extent in the vicinity of Oswego and a considerable amount was used in the construction of Fort Ontario.

Typically, the Medina of western New York is a hard, fine grained sandstone. The quarries usually have a rock face of from 20 to 30 feet, and the layers in the different quarries vary from thin ones, suitable for flagging and curbing, to 4 or 5 feet in thickness. In Niagara county, the principal stratum worked is white sandstone, which is found at the base of the quarries. The white sandstone is overlain by beds of red and variegated sandstone. The upper sandstone layers are usually separated by thin layers of shale. In passing east into Orleans county, the white sandstone becomes less prominent and red and variegated stone constitutes a large proportion of the rock quarried. Some of the quarries produce a pink variety that is very suitable for building purposes.

The quarries in Orleans county are well equipped for producing stone for all purposes for which this stone is used. For building purposes, the Medina stone is well known and it has a very wide market. Many of the large cities of the country and nearly all the cities of the State contain buildings erected wholly or in part of Medina sandstone.

The use of the Medina sandstone for street work is very extensive. For such use the stone is durable and possesses the advantage of not becoming "turtle-backed", but wears even and does not become slippery when smoothed by abrasion.

Shawangunk conglomerate. This formation extends through Ulster and Sullivan counties, with an outlier in Orange county. The rock is mostly a conglomerate at the base, but with some layers of grit near the top. This formation has been but little worked for building stone. The Erie Railroad Co. operates a quarry in this formation at Otisville in Orange county. The Ontario & Western Railroad and the Erie have used this rock to some extent for abutment work at Cornwall in Orange county. Other quarries have been operated to supply local demands. The chief product of this formation is millstones under which title the rock is described in more detail.

In Rensselaer county there is a formation known as the Rensselaer grit. Like the Shawangunk grit it has usually been correlated with the Oneida conglomerate, but it probably belongs to a much higher horizon. The Rensselaer grit is unfavorably situated for transportation facilities and no quarries of importance are operated in this formation.

Clinton sandstone. This formation follows directly above the Medina. It consists of limestones, shales, sandstones and beds of iron ore. The rocks extend from Otsego county west to the Niagara river. In western New York sandstones are not found in this formation, but in the eastern section they constitute an important part of the group. The most extensive sandstone ledges are found in the Mohawk valley from Ilion to beyond Utica. The rock that is quarried consists of reddish brown and gray sandstones. It is quite hard and even grained and is suitable for nearly all kinds of construction work. A ledge 40 to 50 feet thick is found at the top of the formation. This stone is used considerably for foundation work in Utica and other near-by places. Several of the church buildings in Utica are built of this stone.

Devonic sandstones. The lowest sandstone formation of the Devonic is the Oriskany. This is a well known formation and is about 20 feet thick. It is best developed in eastern and central New York. In the western part of the State, when found, it occurs only as a thin bed and in some places it is entirely absent. The outcrop of the Oriskany follows approximately that of the Helderbergian escarpment. On account of the rock being somewhat friable, it is but little used for construction purposes.

In the Upper Devonic, the Hamilton, Portage, Chemung and Catskill formations comprise a great series of alternating beds of sandstones and shales that are developed throughout the central and southern parts of the State and occupy approximately one third of the entire area. The northern and eastern limit of this area is approximately defined by a line passing from Port Jervis in Orange county, northeastwardly to Kingston and along the west side of the Hudson river to a few miles below Albany, and then extending in a broad curve to the north of west, passing a short distance south of Syracuse and almost directly westward to Lake Erie. An outlying area of Middle Devonic rocks is found in Orange county. The rocks consist of coarse beds known as the Bellvale flags and the Skunnemunk conglomerate. A limited area of rocks of Carbonic age is found in Allegany and Cattaraugus counties. The sandstone of the Devonic formation is popularly

known as bluestone and though the term, in its original significance, referred to the Ulster county stone, it is now generally used in a much broader sense.

In eastern New York, the Devonic rocks involved in the sandstone area are represented by beds of coarse sedimentation, quite uniform in lithologic features, extending from the Hamilton to the Catskill, and quarries are operated in all the formations. In passing westward into central and western New York, the Hamilton is represented mostly by shales with a few beds of limestone. In the eastern section a large number of quarries have been opened in southern Greene and the northern portion of Ulster counties. These quarries are located but a short distance west of the Hudson river. Most of the product is shipped by water from Catskill, Greene co. and Saugerties and Kingston, Ulster co. Another important district comprises Sullivan, Delaware and Broome counties; and the chief shipping points are Walton, Hancock, Lordville, Hale Eddy and Fishs Eddy, Delaware co.; Rockland, Livingston Manor and Long Eddy, Sullivan co.; and Deposit, Broome co. The product is shipped mostly by the Erie and the Ontario & Western Railroads.

In central and western New York, the bluestone quarries are confined to the Portage and Chemung groups, with the most important ones in the Portage.

The quarries along Cayuga and Seneca lakes are in the Cashaqua division of the Portage, and include a line of quarries extending from Ovid Center to Taughannock Falls. The quarries at Ithaca are in the Ithaca formation and those around Norwich are of the same horizon. The quarries in the vicinity of Warsaw in Wyoming county are in the High Point sandstone, a still higher division of the Portage. To this same horizon belong the quarries just east of Elmira, Horseheads and at Pine Valley. In western New York a number of quarries have been opened in the Chemung formation and include those to the south of Elmira and most of the quarries in Allegany, Cattaraugus and Chautauqua counties.

Production of sandstone

The total value of the sandstone quarried in New York last year was $2,043,960. This is an increase of $147,263 over 1904. The output was distributed among 35 counties with an aggregate of over 400 producers. Classified as to uses the total was distributed as follows: building stone, rough, $279,728; building stone, dressed, $250,757; curbing, $543,002; flagging, $486,911; paving blocks,

$310,769; crushed for roads, $13,920; crushed for other purposes, $23,486; rubble etc., $27,717; all other purposes, $107,670.

The following tables show the value of the production of sandstone in 1904 and in 1905, distributed among the leading districts of the State. They also indicate the relative proportion of bluestone to the sandstone that was quarried.

Production of sandstone in 1904

DISTRICT	Building stone	Curbing and flagging	Paving blocks	Crushed stone	Rubble, riprap	All other
Bluestone						
Hudson river.....	$99 114	$352 249	$13 394	.....	.....	$44
Delaware river....	117 806	310 913	.....	.....	$3 218	5 043
Chenango county.	85 710	24 100	.....	.....	.....	1 000
Wyoming county.	175 072	300	.....	.....	500	1 502
Other districts....	4 390	16 255	.....	$1 390	100	163
Total bluestone.	$482 092	$703 817	$13 394	$1 390	$3 818	$7 752
Sandstone						
Orleans county....	$115 000	$185 526	$274 846	.....	$1 900	$11 500
Other districts....	40 515	12 684	5 012	$26 193	9 018	2 240
Total sandstone.	$155 515	$198 210	$279 858	$26 193	$10 918	$13 740
Combined total.	$637 607	$902 027	$293 252	$27 583	$14 736	$21 492

Production of sandstone in 1905

DISTRICT	Building stone	Curbing and flagging	Paving blocks	Crushed stone	Rubble, riprap	All other
Bluestone						
Hudson river...	$59 813	$314 791	$6 165	.....	.....	$2 000
Delaware river..	64 084	441 634	2 500	.....	$4 400	.....
Chenango co....	70 066	76 983	988	.....	2 168	5 473
Wyoming co....	171 620	3 000	.....	.....	930	33 433
Other districts..	36 210	59 641	587	$1 102	374	11 282
Total bluestone.	$401 793	$896 049	$10 240	$1 102	$7 872	$52 188
Sandstone						
Orleans county.	$71 679	$119 390	$270 964	$1 282	$3 500	$51 290
Other districts..	57 013	14 474	29 565	35 022	16 345	4 192
Total sandstone.	$128 692	$133 864	$300 529	$36 304	$19 845	$55 482
Combined total.	$530 485	$1 029 913	$310 769	$37 406	$27 717	$107 670

The value of bluestone quarried for all purposes in 1905 was $1,369,244, or approximately 67 per cent of the total sandstone; the value of the other sandstone quarried was $674,716 or 33 per cent of the total. The tables show that there was a slight falling off in the amount of sandstone quarried but enough increase in the amount of bluestone to make the total amount of sandstone quarried larger than that reported in the preceding year.

The production of bluestone by districts was as follows: Hudson river, $382,769; Delaware river, $512,618; Wyoming county, $208,983; Chenango county, $155,678; other districts, $109,196. Of the sandstone quarried, Orleans county reported an output valued at $518,105 and other counties an output valued at $156,611. A more detailed classification of the product that would cover each county separately has been found impracticable, since many of the large companies which operate quarries at several localities are unable to divide their output according to the different sources. The relative rank of the principal counties of the State was, however, as follows in the order of their importance: Orleans, Ulster, Delaware, Wyoming, Sullivan, Chenango and St Lawrence.

The foregoing table shows that of the bluestone quarried along the Hudson river in Albany, Greene and Ulster counties, about 82 per cent was sold as flagstone and curbstone and about 15 per cent as building stone. In the Delaware river districts, including Sullivan, Delaware and Broome counties, the value of the flagstone and curbstone sold amounted to 86 per cent and the building stone to 12 per cent of the total. In Chenango and Wyoming counties, on the other hand, almost the entire output was marketed as building stone, the value of flagstone and curbstone being less than 3 per cent of the total sales. The output of Medina sandstone in Orleans county was used chiefly for the following purposes: building stone, 14 per cent; flagging and curbing, 23 per cent; paving blocks, 52 per cent; other purposes, 10 per cent.

Trap

The basic dike rocks, commonly called trap, are found at numerous places throughout the Adirondacks and adjacent territory. They are particularly well represented in the Champlain valley, where a great number of occurrences have been described by Kemp and others. Among the more accessible localities for these rocks are Saratoga Springs and Fort Ann on the southern border of the Adirondack gneiss area. A diabase dike, 200 feet wide, and trace-

able for over a mile on the strike occurs about 2 miles north of Saratoga Springs on the line of the Adirondack railroad.

The largest outcrop of trap rock in the State is that extending along the west bank of the Hudson river, southward from Haverstraw, constituting the remarkable scenic feature known as the Palisades. This ridge crosses the Rockland county line into New Jersey and continues as far as Bergen Point. The same rock appears again on Staten Island but is not so well marked topographically. The rock is a dark, fine grained, crystalline aggregate of plagioclase, augite and magnetite. It belongs to the diabases. It is exceedingly hard and tough, and unlike most granitic rocks shows little tendency to rifting and parting along planes of weakness, so that it is admirably adapted for paving blocks and road metal, of which the ability to withstand constant wear is an essential feature. A test of the trap from Rockland Lake made in the laboratory for road material at Washington, D. C., gave the following results: coefficient of wear 13.2; per cent of wear 3; weight in pounds a cubic foot, 192.5; pounds of water absorbed a cubic foot, .3; cementing value, 80. Though the trap has been used to some extent in buildings, it is too unyielding in the quarry to be extensively employed for that purpose.

The principal quarries are those at Rockland Lake, Haverstraw, Upper Nyack and Mt Joy, Rockland county, and at Port Richmond, Staten Island. Crushing plants are operated at all the quarries. The product is used for road metal, concrete, railroad ballast, and a small portion for paving blocks and building stone.

Production of trap

MATERIAL	1904		1905	
	Cubic yards	Value	Cubic yards	Value
Crushed stone	610 285	$452 621	774 111	$601 669
Paving blocks etc	.....	15 875	.....	21 550
Total	.....	$468 496	.....	$623 219

The production of trap rock in New York State in 1905 was valued at $623,219, as compared with $468,496, the value of the output in 1904. Of the totals given, $601,669 in 1905 and $452,621 in 1904 represented the value of crushed stone and $21,550 and

$15,875 respectively the value of paving blocks and building material. The total quantity of crushed stone in 1905 was 774,111 cubic yards and in the preceding year 610,285 cubic yards. The greater part of the crushed stone was sold for road material, though the quantities thus used can not be accurately stated. The paving blocks and building stone were quarried on Staten Island. There were seven companies in 1905 that reported an output.

Bibliography

Dickinson, H. T. Quarries of Bluestone and other Sandstones in New York. N. Y. State Mus. Bul. 61. 1903.
Eckel, E. C. The Quarry Industry of Southeastern New York. N. Y. State Geol. 20th An. Rep't. 1902.
Hall, James. Report on Building Stone. N. Y. State Mus. 39th An. Rep't. 1886.
—— Geology of New York: Report on Fourth District. 1843.
Mather, W. W. Geology of New York: Report on First District. 1842.
Merrill, F. J. H. Mineral Resources of New York. N. Y. State Mus. Bul. 15. 1895.
Smock, J. C. Building Stone in the State of New York. N. Y. State Mus. Bul. 3. 1888.
—— Building Stone in New York. N. Y. State Mus. Bul. 10. 1890.
Vanuxem, Lardner. Geology of New York: Report on Third District. 1843.

TALC

The industry based on the mining and preparation of talc is carried on in St Lawrence county, where there are large deposits of foliated and fibrous talc adapted for paper manufacturing and other uses. The deposits occur in a belt of crystalline limestone that is interfolded with, and surrounded by, Adirondack gneiss. The limestone is part of a series of related rocks that are extensively developed on this side of the Adirondacks. It differs, however, from the usual type in having a finer texture and in the more abundant inclusions of silicates, specially tremolite and pyroxene.

The geology of the talc deposits has been studied by C. H. Smyth jr, who has shown that they are the result of chemical alteration of the silicates in the limestone. The method of derivation is described by Dr Smyth as follows:

The tremolite schist represents portions of the limestone formation which contained a large amount of silicious sediment. Metamorphism produced crystallization of the mingled calcareous, magnesian and silicious materials, forming tremolite. Where the calcareous material was in considerable quantity there was formed a tremolite limestone; where it was a minor constituent there was formed a tremolite schist. Under the influence of subterranean waters chemical changes have been produced. The tremolite has taken up the elements of water, the lime has passed away into solution, and talc has resulted.

The mines now under operation lie within an area 7 or 8 miles long and about 1 mile wide, running northeast from Sylvia lake, town of Fowler, to near Edwards, 15 miles east of Gouverneur. The talc deposits range from a few feet up to 50 feet or more in thickness. They are inclined at different angles from the horizontal, the dip being westward. Various grades of talc may be produced from the same deposit, though the general run of the mine is usually uniform. Foliated or leafy talc is particularly abundant in the western mines. The fibrous and massive varieties are most used. The beds are sometimes separated by inclusions of tremolite schist, and this mineral as well as quartz occurs to a limited extent in the product.

The deposits are worked by inclines carried down on the foot wall. From the inclines drifts are run at intervals of about 50 feet and the talc removed between adjacent levels, leaving large pillars to support the roof. The rock is transported from the stopes by tramways. Both machine drills and hand drills are employed for breaking down the talc. The former have little advantage over hand drills for economy, as work must be frequently interrupted to clean the holes, or else the drill rods will bind in the soft but tough rock.

All of the companies engaged in mining operate mills for crushing and grinding the talc. Most of the mills are situated along the Oswegatchie river between Gouverneur and Edwards and are driven by water power. Milling is a tedious and expensive operation. The final grinding is done in a tube mill, consisting of a horizontal cylinder, 6 feet in diameter and 8 feet long, lined with enameled brick. Three tons of flint pebbles are used in the cylinders, and the charge is about 1 ton of talc. The grinding continues for a period of from four to five hours. The rock is prepared for the cylinders by passing through Blake crushers and Griffin mills. The latter have superseded buhr stones, which were formerly used almost exclusively.

The talc is marketed mostly among paper manufacturers. Its fibrous character, pliability and color are qualities which combine to give it an advantage over other materials that are used for filling paper. It is said that a much larger proportion of fibrous talc can be incorporated in paper stock than is possible with clay or other amorphous substance, while at the same time the paper is strengthened by its addition. Among the leading consumers are makers of book, writing and wall paper. The mills making newspaper use relatively smaller quantities than is generally supposed. The

reason commonly given for this is that the grit present in the talc increases the wear of machines when run at high speed as in newspaper mills. In the American paper trade, St Lawrence county talc has become a staple article, while its use in foreign countries has attained to large proportions. Large quantities are exported to Germany, where it competes with the high grade German clays. It is also shipped to Austria, Italy, France, Great Britain and other countries. Among the minor uses for talc are the manufacture of waterproof paints, wall plaster, steam pipe coverings, toilet powders and as an adulterant of soap.

The production of talc in 1905 amounted to 67,000 short tons. The average selling price at Gouverneur on the basis of carload lots was $7 a ton, at which figures the total value was $469,000. In 1904 the production was 65,000 short tons valued at $445,000. There has been little change in the industry during recent years. The following table shows the production for the period 1895-1905, the figures previous to 1904 being taken from the volumes of the *Mineral Resources.*

Production of talc in New York

YEAR	Short tons	Value	Value per ton
1896	46 089	$399 443	$8 67
1897	57 009	396 936	6 96
1898	54 356	411 430	7 57
1899	54 655	438 150	8 02
1900	63 500	499 500	7 87
1901	62 200	483 600	6 99
1902	71 100	615 350	8 65
1903	60 230	421 600	7 ..
1904	65 000	455 000	7 ..
1905	67 000	469 000	7 ..

There are four companies operating in St Lawrence county. The International Pulp Co. owns several mines near Talcville at the eastern end of the range. Four of the properties are worked. Its four mills are situated at Talcville and Hailesboro, where there is large water power. The mine of the United States Talc Co. is situated west of Talcville, while the mill is located at Dodgeville. The Ontario Talc Co. has three mines and one mill located near Fullerville in the central part of the district. On the western end are the two mines of the Union Talc Co., which until recently has

operated three mills, one mill having burned down in 1905. The capacity of the plants is such that the output could be easily enlarged to much greater than the present proportions.

Bibliography

Brinsmade, Robert E. Talc in Northern New York. The Engineering and Mining Journal, Dec. 23, 1905, p.1155.
Smyth, C. H. jr. Report on the Geology of Four Townships in St Lawrence and Jefferson counties. N. Y. State Mus. 47th An. Rep't. 1894.

ZINC AND LEAD

The zinc-lead mine at Ellenville, Ulster co., was not operated during 1905. The property came into the possession of the Backus Lumber Co. of Newark, N. J., in 1901 and exploration was carried on for some time, but the results have not been sufficiently encouraging to warrant active developments.

The Ellenville mine was first operated about 50 years ago, since which time it has been worked intermittently by different companies. It is a noted locality for beautiful quartz crystals. The deposit consists of a fissure vein intersecting the country rock, the Shawangunk grit. The width of the vein averages about 6 feet. Quartz is the principal gangue mineral, while the ore consists of sphalerite, galena and chalcopyrite in varying proportions. Silver is present in the galena to the extent of a few ounces to the ton. The workings comprise an inclined shaft that has been carried down to about 200 feet on the vein and a series of levels 30 feet apart. A mill for treating the ore has been erected near the mine.

Zinc ore occurs at several localities in St Lawrence county. Some of the deposits have been known for many years, but they have received very little attention and have not been worked on a commercial scale. The ore is generally an intimate mixture of the sulfids of iron, lead and zinc, presenting a rather difficult problem in concentration under the methods formerly used. With the present improved processes there is no doubt that the minerals can be separated so as to yield marketable products.

The most promising deposit that has been found in this section is near the village of Edwards, 20 miles east of Gouverneur. It was discovered about three years ago. The ore body outcrops on the Todd and Brown farms, $\frac{3}{4}$ mile northeast of Edwards, on the road leading to Trout lake.

The geologic formations comprise crystalline limestone and hornblendic gneiss, the former occurring as a narrow belt extending for several miles in a northeasterly direction through the towns of

Fowler and Edwards. The limestone belongs to the same series that yields the Gouverneur marble and may be classed as Algonkian. In the section under consideration the limestone is characterized by the abundant presence of silicates, which oftentimes constitute the greater part of the rock mass. The talc mines of St Lawrence county all lie within this limestone belt, the mine first opened being within a short distance of the zinc mine.

The ore is zinc blende, containing some galena and usually considerable pyrite. So far as prospecting operations have gone its occurrence seems to be limited to the limestone near the contact with the gneiss. The gangue is a mixture of calcite and serpentine, the latter being evidently an alteration product, probably of hornblende or pyroxene. The presence of ore is indicated at the surface by rusty, disintegrated material or gossan, due to the oxidation of the pyrite. There is usually only a slight depth of this material, and unaltered zinc blende may be found within a foot or less below the thin soil capping.

The main discoveries are located along a low ridge immediately north of the Oswegatchie river. Near the north end an open cut has been made into the ridge, affording a good exposure of the limestone. The strata have a northeasterly strike and a variable dip to the northwest. At this point the ore seems to occur in irregular bunches aggregated along a band in the limestone. The width of the band of mixed ore and rock is about 15 feet in its maximum development. Masses of ore are also found included in the limestone at some distance from the main body, and the general appearance at this locality is suggestive of a brecciated and possibly faulted deposit.

Several openings have been made south of the one mentioned for a distance of 2000 feet, all showing some ore. At a point about 1000 feet south, a rich band, 5 or 6 feet thick, has been uncovered and followed to a depth of 15 feet. This body lies considerably to the east of the general trend of the principal ore belt, but whether it represents a displaced portion of the latter could not be determined.

The bulk of the ore has a granular texture, with the metallic minerals distributed somewhat regularly through the limestone matrix. The blende shows little or no tendency to crystal form, but the pyrite quite often exhibits a cubical development. The proportion of the latter mineral varies widely, being absent in some specimens and again very abundant. As to the zinc content it is stated that an average sample of the richest ore gave 48%, while the lowest assay showed 13%. About 3000 tons of ore have been

taken out and are now stored at the mine. At a fair estimate, with allowance for loss in milling, this should yield at least 1000 tons of concentrates. Experiments in concentration have been made with the Wetherill magnetic separator and have given very good results. The blende carries 5% or more of iron. It would seem likely that a marketable pyrite product may also be secured.

The mining rights of this property are owned jointly by T. M. Williams of Gouverneur and the firm of Pilling & Crane of Philadelphia, Pa. The development work has been under the charge of Mr Williams. The same parties have secured a lease of the Balmat mine near Sylvia lake about halfway between Edwards and Gouverneur.

The Balmat (also called Belmont) mine was opened in the first part of the last century. It has been described by Emmons[1] as follows:

In the town of Fowler, a remarkable vein of the sulfurets of zinc, lead and iron, in about equal proportions, occurs on the farm of Mr Belmont. The direction of the vein is n. n.e. and s. s.w. and the width about 8 inches, but not well defined. These sulfurets traverse a bed of serpentine 40 to 50 feet wide. The occurrence of zinc intermixed with lead, is not favorable to the reduction of the latter.

There are two shafts on the ore body situated about 1000 feet apart, but the workings are no longer accessible. From what could be seen at the surface, the ore appears to occur as a narrow band or vein in crystalline limestone, attaining a width of 1 to 3 feet. There is much more galena present than in the ore at Edwards and usually more pyrite. No mining has been done on the deposit in recent years.

Lead ores carrying subordinate quantities of zinc are found at Rossie and other places in St Lawrence county. The Rossie deposits have been described by Beck and Emmons, and more recently by C. H. Smyth jr, who has given an interesting account of their associations and probable origin. They are veins, occupying fissures in gneiss, composed of calcite and galena with little pyrite, chalcopyrite and sphalerite. Two varieties of gneiss are distinguished by Dr Smyth, a pink variety of intrusive character and an older gray gneiss which is probably ingenous though its relationships can not be definitely stated. The veins follow approximately parallel directions, cutting across the foliation of the gneiss at a high angle.

[1] Geology of New York: Report on Second District. Assembly Doc. 1838, no. 200, p. 213.

The Coal Hill vein, the largest of the group, has a width of from 2 to 6 feet and is exposed for 450 feet along the strike. According to Emmons, the galena occurs in coarse aggregates, rather irregularly distributed but more abundant in the middle portion than on the walls. Crystal masses weighing over 100 pounds have been found. The Victoria vein ¾ mile east of the former, is said to have been 2½ feet wide at a depth of 40 feet.

The Rossie deposits were opened in 1836. In the two following years, 1625 tons of lead were produced from the Coal Hill vein. The ore was mostly smelted in a local furnace. In 1839 mining was discontinued, but in 1852 the Great Northern Lead Co. secured a lease of the properties and renewed operations, apparently with little success. During the Civil War, the deposits were again worked by the Mineral Point Lead Mining Co., who also owned mines at Mineral Point, on the shore of Black lake. There has been nothing done with the mines during recent years.

Bibliography

Beck, Lewis C. Mineralogy of New York. 1842.
Emmons, E. Geology of New York: Report on Second District. 1842.
Smyth, C. H. jr. The Rossie Lead Veins, School of Mines Quarterly, July 1903.

DIRECTORY OF MINES AND QUARRIES IN NEW YORK STATE

CEMENT

P.=Portland cement *N.*=Natural cement

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Columbia co.		
Hudson Portland Cement Co. (*P.*)	Hudson	Hudson
Erie co.		
Akron Cement Works (*N.*)	Buffalo	Akron
Buffalo Cement Co. (*N.*)	Buffalo	Buffalo
Cummings Cement Co. (*N.*)	Akron	Akron
Newman, H. L. & W. C. (*N.*)	Akron	Akron
Greene co.		
Alsen's American Portland Cement Works (*P.*)	Alsen	Alsen
Catskill Cement Co. (*P.*)	Smiths Landing	Smiths Landing
Livingston co.		
Iroquois Portland Cement Co. (*P.*)	Buffalo	Caledonia
Onondaga co.		
Alvord & Co., E. B. (*N.*)	Jamesville	Jamesville
Bangs-Gaynor Cement & Plaster Co. (*N.*)	Fayetteville	Fayetteville
Behan Cement Works, James (*N.*)	Manlius	Manlius
Britton, I. E. (*N.*)	Syracuse	Syracuse
Empire Portland Cement Co. (*P.*)	Warner	Warner
Millen & Co., Thomas (*N.*)	Jamesville	Jamesville
Potter-Brown Cement Works (*N.*)	Manlius	Pompey
Sheedy, Thomas W. (*N.*)	Fayetteville	Fayetteville
Schoharie co.		
Helderberg Portland Cement Co. (*P. & N.*)	Albany	Howes Cave
Steuben co.		
Millen & Co., Thomas (*P.*)	Wayland	Wayland
Tompkins co.		
Cayuga Lake Cement Co. (*P.*)	Ithaca	Portland Point
Ulster co.		
Consolidated Rosendale Cement Co. (*N.*)	Kingston	Binnewater, Eddyville, Rosendale, Hickory Bush, Wilbur, Whiteport, Lawrenceville
Newark Lime & Cement Mfg. Co. (*N.*)	Newark, N. J.	Rondout
New York Cement Co. (*N.*)	Rosendale	Rosendale
Snyder & Sons, A. J. (*N.*)	Rosendale	Rosendale
Warren co.		
Glens Falls Portland Cement Co. (*P.*)	Glens Falls	Glens Falls

CLAY PRODUCTS

Brick, tile etc.

B. B.=Building brick *S. L.*=Stove lining *T. C.*=Terra cotta
P. B.=Paving brick *D. T.*=Drain tile *F. P.*=Fireproofing
F. B.=Fire brick *S. P.*=Sewer pipe *H. B.*=Hollow brick
B. T. =Building tile

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Albany co.		
Cary Brick Co. (*B. B.*)	Mechanicville	Cohoes
Hunter & Son, Alfred (*B. B.*)	Albany	Albany
Jackson, John H. (*D. T. & B. T.*)	Albany	Albany
Moore, J. C., & Babcock (*B. B.*)	Albany	Albany
Newton Fire Brick Co. (*F. B. & S. L.*)	Albany	Albany
Poutre, Antoine (*B. B.*)	Albany	Albany
Retallick, H. E. (*B. B.*)	Watervliet	Watervliet
Smith, Edward J. (*B. B.*)	Albany	Albany
Sutton & Sinspaugh (*B. B.*)	Coeymans	N. Coeymans
Sutton & Suderley Brick Co. (*B. B.*)	Coeymans	Coeymans
Allegany co.		
Alfred Clay Co. (*B. B. & B. T.*)	Alfred	Alfred Station
Celadon Roofing Tile Co. (*B. T.*)	New York	Alfred
Broome co.		
Nanticoke Brick & Tiling Co. (*B. B.*)	Union	Union
Ogden Brick Co. (*B. B.*)	Binghamton	Binghamton
Wells & Brigham (*B. B.*)	Binghamton	Lestershire
Cattaraugus co.		
Colligan, Michael J. (*B. B.*)	Allegany	Allegany
McMurray, J. C. & A. (*B. B.*)	Olean	Olean
Cayuga co.		
Genoa Brick & Tile Co. (*D. T.*)	Genoa	Genoa
Hare, J. H. (*B. B. & D. T.*)	Owasco	Owasco
Harvey, Fred W. (*B. B.*)	Auburn	Auburn
Saunders Bros. (*B. B.*)	Auburn	Fleming
Venice Tile Works (*D. T.*)	Venice Center	Venice Center
Webber, Fred (*B. B. D. T.*)	Auburn	Throop
Chautauqua co.		
Hilton, Mrs John (*B. B.*)	Dunkirk	Dunkirk
Hilton, Walter E. (*B. B.*)	Dunkirk	Dunkirk
Jamestown Shale Paving Brick Co. (*B. B. & P. B.*)	Jamestown	Jamestown
Morley, C. A. sr & Co. (*B. B.*)	Jamestown	Levant
Red Star Brick Co. (*B. B. & F. P.*)	Warren, Pa.	Falconer
Chemung co.		
Elmira Fire Brick & Stoneware Works (*F. B.*)	Elmira	Elmira
Elmira Shale Brick Co. (*B. B.*)	Horseheads	Elmira
Horseheads Brick Co. (*B. B.*)	Horseheads	Horseheads
Clinton co.		
McCarthy, James (*B. B.*)	South Plattsburg	South Plattsburg
Ouinette, Joseph (*B. B.*)	Plattsburg	Plattsburg

Brick, tile, etc. (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Columbia co.		
Arkison Bros. (*B. B.*)	Hudson	Hudson
Bartlett Brick Co. (*B. B.*)	Hudson	Hudson
Bronsseau, Hannah P. (*B. B.*)	Schodack Landing	Stuyvesant
Cary Brick Co. (*B. B.*)	Mechanicville	Newton Hook
Empire Brick & Supply Co. (*B. B.*)	Empire	Empire
Gilbert, A. L. (*B. B.*)	New York	Hudson
Cortland co.		
Hall, Horace W. (*B. B.*)	Homer	Homer
Dutchess co.		
Aldridge Brick Co. (*B. B.*)	Dutchess Junction	Dutchess Junction
Anchor Brick Co. (*B. B.*)	Dutchess Junction	Dutchess Junction
Bourne, C. Clayton (*B. B.*)	Newburgh	Fishkill on the Hudson
Brockway Brick Co. (*B. B.*)	Brockway	Brockway
Brockway Bros. Co. (*B. B.*)	Brockway	Dutchess Junction
Budd Brick Co. W. D. (*B. B.*)	Dutchess Junction	Dutchess Junction
Dennings Point Brick Co. (*B.B.*)	Fishkill on the Hudson	Dennings Point
Flagler & Allen (*B. B.*)	Poughkeepsie	Arlington
Haight, William H. (*B. B.*)	Poughkeepsie	Arlington
Hammond & Freeman (*B. B.*)	New York	Dutchess Junction
Hammond, W. K. (*B. B.*)	New York	Dutchess Junction
Lahey, William (*B. B.*)	Newburgh	Fishkill
Northrip, P. A. (*B. B.*)	Newburgh	Dutchess Junction
O'Brien & Vaughey (*B. B.*)	Verplanck	Fishkill on the Hudson
Paye & Shackett (*B. B.*)	Fishkill on the Hudson	Fishkill on the Hudson
Timoney, Margaret (*B. B.*)	Dutchess Junction	Dutchess Junction
Watrous, F. B. (*B. B.*)	Chelsea	Chelsea
Willson & Eaton Co. (*B. B.*)	Amenia	Amenia
Erie co.		
Bender, Henry (*B. B.*)	Buffalo	Gardenville
Berrick's Sons, Charles (*B. B.*)	Buffalo	Buffalo
Brush Bros. (*B. B.*)	Buffalo	East Buffalo
Buffalo Clay Mfg. Co. (*B. B.*)	Buffalo	Orchard Park
Dietschler's Sons, Henry (*B. B.*)	Buffalo	Buffalo
Ellicott Brick Co. (*B. B.*)	Buffalo	Jewettville
Graap, William J. (*B. B.*)	Buffalo	Cheektowaga
Haak Estate, Fred W. (*B. B.*)	North Collins	North Collins
Hall & Sons (*F. B. & S. L.*)	Buffalo	Buffalo
Jewettville Pressed & Paving Brick Co. (*B. B.*)	Buffalo	Jewettville
Lancaster Brick & Tile Co. (*D. T., F. P. & B. T.*)	Buffalo	Lancaster
Lyth & Sons, John (*B. B. D. T., F. P. & B. T.*)	Buffalo	Angola
McCutcheon, C. H. (*B. B.*)	Buffalo	Lancaster
Schmidt, George W. (*B. B.*)	Buffalo	Buffalo
Schnesler, Edward A. (*B. B.*)	Buffalo	Buffalo
Tonawanda Brick Co. (*B. B.*)	Tonawanda	Tonawanda
Weyer & Co., O. W. (*B. B.*)	Weyer	Weyer
Essex co.		
Call Brick Yard (*B. B.*)	Keene	Keene
Fulton co.		
Cayadutta Brick Co. (*B. B.*)	Gloversville	Johnstown
Kilmer, Robert M. & Son (*B. B.*)	Johnstown	Hillside Park

Brick, tile etc. (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Genesee co.		
Peck & Wood (*B. T. & D. T.*)	East Bethany	Bethany
Greene co.		
Fitzgerald, Catherine (*B. B.*)	Hudson	Coxsackie
Goldin, Percivil (*B. B.*)	Catskill	Catskill
Haigh, Henry (*B. B.*)	Catskill	Catskill
Kaaterskill Paving Brick Co. (*B. B. & P. B.*)	Catskill	Catskill
Mayone, Joseph (*B. B.*)	Glasco	Athens
Rider, W. W. (*B. B.*)	Athens	Catskill
Washburn & Co., George W. (*B. B.*)	Catskill	Catskill
Herkimer co.		
Guile, R. J. (*B. B.*)	Dolgeville	Dolgeville
Ilion Brick Works (*B. B.*)	Ilion	Ilion
Morgan, A. D. (*B. B.*)	Ilion	Ilion
Jefferson co.		
Godkin & Allen (*B. B.*)	Watertown	Watertown
Houghton, C. (*B. B.*)	Carthage	Carthage
Watertown Pressed Brick Co. (*B. B.*)	Watertown	Watertown
Wrape & Peck (*B. B.*)	Carthage	Carthage
Kings co.		
Brooklyn Fire Brick Works (*F. B. & S. L.*)	Brooklyn	Brooklyn
Brooklyn Stove Lining Co. (*S. L.*)	Brooklyn	Brooklyn
Central Pottery (*F. P.*)	Brooklyn	Brooklyn
Greenpoint Fire Brick Works (*F. B. & S. L.*)	Brooklyn	Brooklyn
New York Vitrified Tile Works (*B. T.*)	Brooklyn	Brooklyn
Livingston co.		
The Craig Colony for Epileptics (*B. B.*)	Sonyea	Sonyea
Madison co.		
Devendorf & Laning (*B. B. D. T.*)	Chittenango	Chittenango
Hall, Francis L. (*B. B.*)	Oneida	Oneida
Monroe co.		
New York Sewer Pipe Co. (*S. P.*)	Rochester	Rochester
Rochester Brick & Tile Mfg. Co. (*B. B., D. T. & B. T.*)	Rochester	Brighton
Rochester German Brick & Tile Co. (*B. B., D. T. & F. P.*)	Rochester	Gates
Rochester Sewer Pipe Co. (*S. P.*)	Rochester	Rochester
Sibley, Estate of H. (*B. B.*)	Rochester	Maplewood
Standard Sewer Pipe Co. (*S. P. & B. T.*)	Rochester	Gates
Montgomery co.		
Grieme, Estate of Henry C. (*B. B.*)	Amsterdam	Amsterdam
Nassau co.		
Post, W. & J. (*B. B.*)	East Williston	Glen Head
Queens County Brick Mfg. Co. (*B. B.*)	Farmingdale	Farmingdale
New York co.		
City Fire Proofing Co. (*F. P.*)	New York	New York

Brick, tile etc. (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Niagara co.		
Frontier Brick Works (*B. B.*)	Niagara Falls	Lewiston
Kruse, Carl F. (*B. B.*)	Wilson	Wilson
Lasalle Brick Works Inc. (*B. B.*)	La Salle	La Salle
Lockport Stone & Brick Co. (*B. B.*)	Lockport	Lockport
Shaw, E. H. (*B. B.*)	Middleport	Hartland
Oneida co.		
Doyle, John (*B. B.*)	Utica	Marcy
Parry, Watkyn W. (*B. B.*)	Rome	Rome
Sangerfield B. & T. Co. (*B. B. & D. T.*)	Sangerfield	Sangerfield
Weaver's Sons, George F. (*B. B.*)	Utica	Utica
White's Pottery, Inc. (*F. B.*)	Utica	Utica
Onondaga co.		
Jordan Tile Works (*D. T.*)	Jordan	Jordan
Kirkville Brick Co. (*B. B.*)	Auburn	Kirkville
Merrick, C. & L. (*B. B. & H. B.*)	Syracuse	Dewitt
National Pressed Brick Co. (*B. B. & F.B.*)	Syracuse	Belle Isle
National Web Tile Sewer Co. (*S. P.*)	Syracuse	Warner
N. Y. Brick & Paving Co. (*B. B. & P. B.*)	Syracuse	Syracuse
Onondaga Vitrified Brick Co. (*B. B. & H. B.*)	Syracuse	Warner
Pack & Son, George W.(*B. B.*)	Syracuse	Salina
Ontario co.		
Abbey, Benton G. (*D. T.*)	East Bloomfield	Allens Hill
Baldwin J. F. (*B. B.*)	East Geneva	East Geneva
Childs, Albert S. (*D. T.*)	Geneva	Seneca Castle
Dove, W. G. (*B. B.*)	Geneva	Geneva
Gorham Brick & Tile Works (*D. T.*)	Stanley	Gorham
Hollis Co., A. M. (*D. T.*)	Canandaigua	Canandaigua
N. Y. Hydraulic Press Brick Co. (*B. B.*)	Rochester	Canandaigua
Peck, Charles (*D. T.*)	Phelps	Phelps
Orange co.		
Arrow Brick Works (*B. B.*)	Roseton	Roseton
Bartlett Brick Co. (*B. B.*)	Roseton	Roseton
Cism & Washburn (*B. B.*)	Chelsea	Chelsea
Davidson, Hugh (*B. B.*)	New Windsor	New Windsor
Goshen Brick & Tile Works (*B. B.*)	Goshen	Goshen
Gregg, William C. (*B. B.*)	Newburgh	New Windsor
Hayden, Matthew (*B. B.*)	Newburgh	New Windsor
Hedges Brick Co. (*B. B.*)	Cornwall on the Hudson	Cornwall
Jova Brick Works (*B. B.*)	Roseton	Roseton
Lahey, William (*B. B.*)	Newburgh	New Windsor
Rose Brick Co. (*B. B.*)	Roseton	Roseton
Ryan & McFarren (*B. B.*)	New York	New Windsor
Smith, Stephen A. (*B. B.*)	Middletown	Middletown
Vernon, M. H. (*B. B.*)	Florida	Florida
Orleans co.		
Lafler, Charles L. (*B. B.*)	Albion	Albion

Brick tile etc. (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Queens co.		
N. Y. Architectural Terra Cotta Co. (*T. C.*)	New York	Long Island City
Rensselaer co.		
Cary Brick Co. (*B. B.*)	Mechanicville	Troy
Dolin, John (*B. B.*)	Hoosick Falls	Hoosick Falls
Dufresne Brick Co. (*B. B.*)	Troy	Troy
Glass, & Co. Robert (*B. B.*)	Troy	Troy
McLeod & Henry Co. (*F. B. & S. L.*)	Troy	Troy
Ostrander Fire Brick Co. (*F. B.*)	Troy	Troy
Painton, Charles R. (*B. B.*)	Troy	Troy
Roberts, Jeremiah (*B. B.*)	Troy	Troy
Troy Brick Co. (*B. B.*)	Troy	Lansingburg
Troy Fire Proofing Co. (*B. B. & F. P.*)	Troy	Troy
Richmond co.		
Atlantic Terra Cotta Co. (*T. C.*)	New York	Tottenville
Kreischer Brick Mfg. Co. (*B. B. & F. B.*)	New York	Kreischerville.
Richmond Brick Co. (*B. B.*)	New York	Green Ridge
Rockland co.		
Allison & Co., B. J. (*B. B.*)	Haverstraw	Haverstraw
Allison & Wood (*B. B.*)	Haverstraw	Haverstraw
Archer, Charles L. & G. (*B. B.*)	Haverstraw	Haverstraw
Bennett & Co., Mrs W. (*B. B.*)	Haverstraw	Haverstraw
Brophy & Sons, Patrick (*B. B.*)	Grassy Point	Grassy Point
Byrnes, James J. (*B. B.*)	Haverstraw	Stony Point
Coyne & Tanney (*B. B.*)	Haverstraw	Haverstraw
De Noyelles & Co. (*B. B.*)	Haverstraw	Haverstraw
Dunnegan, Mrs F. L. (*B. B.*)	Haverstraw	Stony Point
Excelsior Brick Co. (*B. B.*)	Haverstraw	Haverstraw
Fowler jr, & Co., Denton (*B. B.*)	Haverstraw	Haverstraw
Fowler & Son, Denton (*B. B.*)	Haverstraw	Haverstraw
Gardner Brick Works (*B. B.*)	Haverstraw	Haverstraw
Gormley, M. (*B. B.*)	Haverstraw	Haverstraw
Gormley & Cahill (*B. B.*)	Haverstraw	Haverstraw
Heitlinger & Rose (*B. B.*)	Stony Point	Haverstraw
Lynch Bros. (*B. B.*)	Haverstraw	Haverstraw
Lynch & O'Brien (*B. B.*)	Haverstraw	Haverstraw
Maguire, Terrance (*B. B.*)	Haverstraw	Haverstraw
Malley Estate, T. (*B. B.*)	Haverstraw	Haverstraw
Nicholson, John (*B. B.*)	Haverstraw	Haverstraw
Peck Brick Co. (*B. B.*)	West Haverstraw	Haverstraw & West Haverstraw
Reilly, John (*B. B.*)	Haverstraw	Haverstraw
Reilly Brick Co. (*B. B.*)	Stony Point	Stony Point
Reilly & Tanney (*B. B.*)	Stony Point	Stony Point
Renn & Co., E. N. (*B. B.*)	Haverstraw	Haverstraw
Shankey & Son, Thomas (*B. B.*)	Haverstraw	Haverstraw
Snedeker Bros. (*B. B.*)	Haverstraw	Haverstraw
Tanney & Co., T. (*B. B.*)	Haverstraw	Haverstraw
Washburn & Co., L. H. (*B. B.*)	Haverstraw	Haverstraw
Washburn & Co., U. F. (*B. B.*)	Haverstraw	Haverstraw
Washburn & Fowler (*B. B.*)	Haverstraw	Haverstraw
Wood, G. S. & Allison (*B. B.*)	Haverstraw	Haverstraw
St Lawrence co.		
Flaherty, M. H. (*B. B.*)	Massena	Massena
Paige & Co., A. A. (*B. B.*)	Ogdensburg	Ogdensburg

Brick, tile etc. (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Saratoga co.		
Champlain Brick Co. (*B. B.*)	Mechanicville	Mechanicville
Dempsey-Gabriels Brick Co. (*B. B.*)	Crescent	Crescent
Empire State Drain Tile Works (*D. T.*)	Bemis Heights	Bemis Heights & Wilbur Basin
Ferris Paving Brick Co. (*P. B.*)	Mechanicville	Stillwater
Mansfield, William K. (*B. B.*)	Crescent	Crescent
New England Brick Co. (*B. B.*)	Boston, Mass.	Mechanicville
Newton, A. C. (*B. B.*)	Crescent	Crescent
Schenectady co.		
Case, Sherman A. (*B. B.*)	Schenectady	Glenville
Teller, Henry Y. (*B. B.*)	Schenectady	Schenectady
Seneca co.		
Geneva Brick Co. (*B. B.*)	Geneva	Border City
Seigfred, Frank (*B. B.*)	Seneca Falls	Seneca Falls
Willower & Pontius (*D. T.*)	West Fayette	West Fayette
Yerkes, John M. (*B. B.*)	Romulus	Romulus
Steuben co.		
Brick Terra Cotta & Tile Co. (*B. B., P. B. & T. C.*)	Corning	Corning
Preston Brick Co. (*B. B. P. B.*)	Hornellsville	Hornellsville
Schwingel & Fenstermacher (*B. B.*)	Dansville	South Dansville
Suffolk co.		
Long Island & Fishers Island Brick Co. (*B. B.*)	Fishers Island	Fishers Island & Sag Harbor
Sage Brick Mfg. Co. (*B. B.*)	Greenport	Greenport
Sanford, C. L. (*B.B.*)	Southold	Southold
Tioga co.		
Spencer Red Brick Co. (*B. B.*)	Ithaca	Spencer
Tompkins co.		
East Ithaca Red Brick & Tile Co. (*B. B.*)	Ithaca	Ithaca
Inter-State Conduit & Brick Co. (*B. B.*)	Scranton, Pa.	Newfield
Ulster co.		
Brigham Bros. (*B. B.*)	East Kingston	East Kingston
Dinan, Thomas (*B. B.*)	East Kingston	East Kingston
Frederick Brick Co. (*B. B.*)	Kingston	East Kingston
Goldrick, Philip (*B. B.*)	Haverstraw	Goldrick Landing
Hendricks, Clarence P. (*B. B.*)	East Kingston	East Kingston
Hutton Co., The (*B. B.*)	Rondout	Kingston
Kline, Jacob (*B. B.*)	Port Ewen	Port Ewen
Lent, Robert (*B. B.*)	Glasco	Glasco
Lowe & Sons (*B. B.*)	New Paltz	New Paltz
Lynch Bros. (*B. B.*)	East Kingston	East Kingston
Maginnis John C. (*B. B.*)	Glasco	Glasco
Main & Co., Robert (*B. B.*)	Kingston	Kingston
Mayone, Joseph (*B. B.*)	Glasco	Glasco
Rose & Co., A. (*B. B.*)	Kingston	Town of Ulster
Schleede, Christian (*B. B.*)	Port Ewen	Port Ewen
Schultz, Charles A., Estate of (*B. B.*)	East Kingston	East Kingston
Shahan, George A. (*B. B.*)	Saugerties	Glasco
Smith, F. H. & A. H. (*B. B.*)	Kingston	Flatbush

Brick, tile etc. (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Ulster co. (*cont'd*)		
Staples, A. S. (*B. B.*)	Rondout	East Kingston
Terry Brick Co. (*B. B.*)	Kingston	Kingston
Turner, M. E. (*B. B.*)	Fly Mountain	Port Ewen
Washburn Bros., Co. (*B. B.*)	Glasco	Glasco
Washburn, W. F. & J. T. (*B. B.*)	Saugerties	East Kingston
Warren co.		
Glens Falls Brick Co. (*B. B.*)	Glens Falls	Glens Falls
Washington co.		
Adams & Co., Jeremiah (*B. B.*)	Whitehall	Whitehall
Hilfinger Bros. (*S. L., D. T. & S. P.*)	Fort Edward	Fort Edward
Pepper, J. H. (*B. B.*)	Middle Granville	Middle Granville
Sandy Hill Brick Co. (*B. B.*)	Sandy Hill	Fort Edward
Wayne co.		
Johnson, J. B. (*D. T.*)	Lyons	Lyons
Westchester co.		
Bellefenette, E. D. (*B. B.*)	Montrose	Georges Island
Bonner Brick Co. (*B. B.*)	New York	Verplanck point
Frost, Eugene (*B. B.*)	Croton	Montrose point
King & Lynch (*B. B.*)	Verplanck	Verplanck
Mackey, William H. & Co. (*B. B.*)	Verplanck	Verplanck
Manning, Jos. H. (*B. B.*)	Crugers	Crugers
Morton, John G. (*B. B.*)	Croton-on-Hudson	Montrose
Nieberg, R. & Co. (*B. B.*)	Crugers	Crugers
O'Brien, Philip (*B. B.*)	Verplanck	Verplanck
Peekskill Fire Brick Works (*F. B. & S. L.*)	Peekskill	Peekskill
Underhill Brick Co., W. A. (*B. B.*)	New York	Croton-on-Hudson
Wyoming co.		
Attica Brick & Tile Co. (*B. B. & D. T.*)	Attica	Attica

Pottery

S. W.=Stoneware *Y. W.*=Yellow ware *G. W.*=Granite & semi-porcelain
E. S.=Electric supplies *E. W.*=Earthenware *C. P.*=Clay tobacco pipes
P. W.=Porcelain ware *San. W.*=Sanitary ware *A. P.*=Artistic pottery

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Albany co.		
Albany City Pottery (*E. W.*)	Albany	Albany
Chemung co.		
Elmira Fire Brick & Stoneware Works (*S. W.*)	Elmira	Elmira
Erie co.		
Betz & Bros., Henry (*E. W.*)	Buffalo	Buffalo
Buffalo Pottery Co. (*G. W.*)	Buffalo	Buffalo
Kings co.		
Continental Pipe Works (*C. P.*)	Brooklyn	Ridgewood
Empire China Works (*E. S.*)	Brooklyn	Brooklyn
Graham Chemical Pottery Works (*S. W. & San. W.*)	Brooklyn	Brooklyn
Greenpoint Pottery (*S. W.*)	Brooklyn	Brooklyn
Umbach, Gottlieb (*S. W.*)	Brooklyn	Brooklyn
Union Porcelain Works (*P. W.*)	Brooklyn	Brooklyn

Pottery (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF PLANT
Madison co.		
Central New York Pottery Co. (*Y. W.*)	Chittenango	Chittenango
Monroe co.		
Rochester City Pottery (*S. W.*)	Rochester	Rochester
Nassau co.		
Benkert, John B. (*S. W., E. W. & Y. W.*)	Corona	Corona
Oneida co.		
White's Pottery, Inc. (*S. W.*)	Utica	Utica
Onondaga co.		
Onondaga Pottery Co. (*P. W.*)	Syracuse	Syracuse
Pass & Seymour, Inc. (*E. S.*)	Solvay	Solvay
Reagan, Edward (*C. P.*)	Syracuse	Syracuse
Syracuse Pottery Co. (*E. W.*)	Syracuse	Syracuse
Ontario co.		
Locke Insulator Mfg. Co. (*E. S.*)	Victor	Victor
Schenectady co.		
Weber Electrical Co. (*E.S.*)	Schenectady	Bellevue
Suffolk co.		
Bronwer jr, T. A. (*A. P.*)	West Hampton	West Hampton
Washington co.		
Hilfinger Bros. (*S. W. & E. W.*)	Fort Edward	Fort Edward
Wayne co.		
Lyons Stoneware Co. (*S. W.*)	Lyons	Lyons

Clay miners

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Albany co.		
Albany Slip Clay Co.	Albany	Albany
Empire Clay Mfg. Co.	Albany	Albany
Nassau co.		
Aluria Dev. & Mfg. Co. Ltd.	Locust Valley	Locust Valley
Carpenter, Coles A.	Sea Cliff	Glen Cove
Onondaga co.		
Zimmerman, George F.	Belle Isle	Belle Isle
Richmond co.		
Staten Island Kaolin Co.	Troy	Rossville
Storer Bros.	Kreischerville	Kreischerville
Turner, N. A.	Rossville	Kreischerville
Suffolk co.		
Lillis, Johanna	Port Jefferson	Port Jefferson
Williamson, John N.	New York	Centerport

DIATOMACEOUS EARTH

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Herkimer co.		
Searles, George W.	Herkimer	White Lead Lake

EMERY

NAME OF PRODUCER	POSTOFFICE	LOCATION OF MINE
Westchester co.		
Blue Corundum Mining Co.	Boston, Mass.	Peekskill
Hampden Corundum Wheel Co.	Springfield, Mass.	Peekskill
Lancaster, J. R.	Peekskill	Peekskill
Quinn, H. M.	Frankford, Pa.	Peekskill
The Tanite Co.	Stroudsburg, Pa.	Peekskill

FELDSPAR AND QUARTZ

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Westchester co.		
Bridgeport Wood Finishing Co.	New Milford, Ct.	Bedford
Kinkel, & Sons P. H.	Bedford	Bedford

GARNET

NAME OF PRODUCER	POSTOFFICE	LOCATION OF MINE
Essex co.		
Barton & Son Co., H. H.	Philadelphia, Pa.	North River
Behr, Herman Co.	New York	North River
North River Garnet Co.	Ticonderoga	North River

GLASS SAND

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Oneida co.		
Bentley, J. L.	Fish Creek	Fish Creek
Gifford, A. L.	Rome	Rome
Oswego co.		
Marsden, F. L.	Cleveland	Cleveland
Oneida Lake Sand Mine	Cleveland	Cleveland

GRAPHITE

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Essex co.		
Columbia Graphite Co.	Pittsburg, Pa.	Crown Point
Dixon Crucible Co., Joseph	Jersey City, N. J.	Ticonderoga
Niagara co.		
International Acheson Graphite Co.	Niagara Falls	Niagara Falls[1]
St Lawrence co.		
Macomb Graphite Co.	De Kalb Junction	Pope Mills
Warren co.		
International Graphite Co.	Glens Falls	Potterville
Washington co.		
Adirondack Mining & Milling Co.	Whitehall	Dresden
Champlain Graphite Co.	Whitehall	Whitehall
Silver Leaf Graphite Co.	Whitehall	Whitehall

GYPSUM

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Cayuga co.		
Cayuga Plaster Co.	Union Springs	Union Springs
Erie co.		
Akron Gypsum Co.	Akron	Akron

[1] Location of works. Manufacture graphite by electric process.

GYPSUM (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Genesee co.		
Oakfield Plaster Mfg. Co.	Buffalo	Oakfield
U. S. Gypsum Co.	Chicago, Ill.	Oakfield
Madison co.		
Button, R. D.	Canastota	Cottons
Cotton, Arthur	Valley Mills	Valley Mills
Hodge Mrs Hattie C.	Perryville	Blakeslee
Mason, J. jr,	Clockville	Clockville
Miller, F. A.	Clockville	Clockville
Monroe co.		
Consolidated Wheatland Plaster Co.	Caledonia	Wheatland
Garbutt Gypsum Co.	Garbutt	Garbutt
Lycoming Calcining Co.	Williamsport, Pa.	Garbutt
Monarch Plaster Co.	Caledonia	Wheatland
Onondaga co.		
Adamant Plaster Co.	Syracuse	Dewitt
Alvord & Co., E. B.	Jamesville	Jamesville
Bangs-Gaynor Cement & Plaster Co.	Fayetteville	Manlius
Behan Estate, James	Manlius	Manlius
Lansing, H. H.	Fayetteville	Dewitt
Millen Co., Thomas	Jamesville	Dewitt
Miller, Clifford L.	New York	Fayetteville
National Wall Plaster Co.	Syracuse	Dewitt
Severance, F. M.	Fayetteville	Fayetteville
Sheedy, T. W.	Fayetteville	Fayetteville
Snook, C. A.	Fayetteville	High Bridge
Valentine, William, jr	Jamesville	Jamesville
Walrath, Theodore	Manlius Center	Manlius Center
Ontario co.		
Conover, Theodore	Victor	Victor
Grinnell, Ezra	Port Gibson	Port Gibson

IRON ORE

NAME OF PRODUCER	POSTOFFICE	LOCATION OF MINE
Cayuga co.		
Fair Haven Iron Co.	Albany	Fair Haven
Clinton co.		
Arnold Mining Co.	Arnold	Arnold
Chateaugay Ore & Iron Co.	Lyon Mountain	Lyon Mountain
Dutchess co.		
Amenia Mine	Amenia	Amenia
Essex co.		
Port Henry Iron Ore Co.	Mineville	Port Henry
Witherbee, Sherman & Co.	Mineville	Mineville
Herkimer co.		
Salisbury Steel & Iron Co.	Utica	Salisbury
Jefferson co.		
Old Sterling Iron Co.	New York	Antwerp
Oneida co.		
Borst Charles A.	Clinton	Washington Mills & Clinton
St Lawrence co.		
Rossie Iron Ore Co.	New York	Sprague ville
Wayne co.		
Furnaceville Iron Co.	Ontario Center	Ontario

MILLSTONES

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Ulster co.		
Braught, Daniel	New Paltz	New Paltz
Coddington, Frank	St Josen	St Josen
Coddington, John	St Josen	St Josen
Coddington, Virgil	St Josen	St Josen
Crose, John	Kerhonkson	Kerhonkson
Davenport, Ira	St Josen	St Josen
Davis, Joseph P	Kerhonkson	Kerhonkson
Decker, Asa	Granite	Granite
Decker, Miles	Kerhonkson	Granite
De Puy, J. S.	St Josen	St Josen
Esopus Millstone Co.	Kingston	Accord
Hasbrouck, Bruyn	New Paltz	New Paltz
Hendrickson, John	Alligerville	Alligerville
Lawrence, Fred	Alligerville	Alligerville
Lawrence, G. B.	Wawarsing	Wawarsing
Lawrence, Moses D.	St Josen	Rochester
Lawrence, Russell	Accord	St Josen
Lounsberg & Son, E. D.	Kerhonkson	Kerhonkson
Percell, Asa	Alligerville	Shawangunk
Percell, David	Alligerville	Alligerville
Rose & Smith	Accord	St Josen
Schoonmaker, James	Kerhonkson	Kerhonkson
Slater, Charles	Kerhonkson	Granite
Smith, Edward	Kerhonkson	Kerhonkson
Van Etten, Ambrose	Kerhonkson	Granite
Van Etten, James S.	Granite	Granite
Vanlawer, Hiram, jr	New Paltz	New Paltz
Van Lewen, William H.	New Paltz	New Paltz

MINERAL PAINT

M.=mines crude rock or ore and sells to paint manufacturers

NAME OF PRODUCER	POSTOFFICE	LOCATION OF MINE OR WORKS
Cattaraugus co.		
Elko Paint Co.	Randolph	Randolph
Oneida co.		
Borst, Charles A. (*M.*)	Clinton	Clinton
Clinton Metallic Paint Co.	Clinton	Clinton
Rensselaer co.		
Connors Paint Mfg. Co., Wm.	Troy	Troy
Hurd, A. J. (*M.*)	Eagle Bridge	Eagle Bridge
Ruff, Andrew (*M.*)	Troy	Troy
St Lawrence co.		
Rossie Iron Ore Paint Co.	Ogdensburg	Keens Station
Washington co.		
Algonquin Red Slate Co. (*M.*)	Truthville	Truthville
Staso Company	Boston, Mass.	Middle Granville
Wetherill & Eddy Co.	Whitehall	Whitehall
Wayne co.		
Furnaceville Iron Co.	Ontario Center	Ontario
Williams Co., C. K.	Easton, Pa.	Ontario

NATURAL GAS[1]

NAME OF PRODUCER	POSTOFFICE
Allegany-Cattaraugus counties	
Andover Gas Co.	Andover
Empire Gas & Fuel Co.	Wellsville
Gowanda Natural Gas Co.	Gowanda
Hall, W. R.	Perrysburg
Hazelwood Oil Co.	Pittsburg, Pa.
Mutual Gas Co.	Andover
Newcomb, D. L.	Perrysburg
Producers Gas Co.	Olean
United Natural Gas Co.	New York
Chautauqua co.	
Dunkirk Gas Co.	Dunkirk
Silver Creek Gas & Improvement Co.	Silver Creek
South Shore Gas Co.	Silver Creek
Erie co.	
Alden-Batavia Natural Gas Co.	Binghamton
Akron Natural Gas Co.	Akron
Boro Oil & Gas Co.	Collins
Depew & Lancaster Light, Power & Conduit Co.	Lancaster
Lancaster - Depew Natural Gas Co.	Lancaster
Niagara Light, Heat & Power Co.	Tonawanda
Springville Natural Gas Co.	Springville
United Natural Gas Co.	New York
Williamsville Natural Gas Co.	Buffalo
Genesee co.	
Corfu Gas Co.	Corfu
Empire Gas & Fuel Co.	Wellsville
Livingston co.	
Caledonia Natural Gas Co.	Caledonia
Onondaga co.	
Baldwinsville Heat & Light Co.	Baldwinsville
Phoenix Fuel & Light Co.	Phoenix
Ontario co.	
Ontario Gas Co.	Honeoye Falls
Oswego co.	
Pulaski Gas & Oil Co., Ltd.	Pulaski
Sandy Creek Oil & Gas Co.	Lacona
Wyoming co.	
Attica Natural Gas Co.	Attica
Attica Water, Gas & Electric Co.	Attica
Yates co.	
Rushville Mining & Gas Co.	Rushville

[1]This list includes the companies producing and distributing gas for public use, the names of small producers of gas for private use being omitted.

PYRITE

NAME OF PRODUCER	POSTOFFICE	LOCATION OF MINE
St Lawrence co.		
Adirondack Pyrite Co.	Gouverneur	Gouverneur
National Pyrite Co.	Canton	Pyrites
St Lawrence Pyrite Co.	Hermon	De Kalb

SALT

NAME OF PRODUCER	POSTOFFICE	LOCATION OF DEPOSIT
Genesee co.		
Le Roy Salt Co.	Leroy	Leroy
Livingston co.		
Genesee Salt Co.	Piffard	Piffard
Retsof Mining Co.	Scranton, Pa.	Retsof
Onondaga co.		
Boyd, W. B.	Syracuse	Syracuse
Cady & Johnson	Syracuse	Syracuse
Corkings, Philip	Syracuse	Syracuse
Draper & Porter	Syracuse	Syracuse
Empire Coarse Salt Co.	Syracuse	Syracuse
Gale, Thomas K.	Syracuse	Syracuse
Geddes Coarse Salt Co.	Syracuse	Solvay
Gere, W. A. & J. B.	Syracuse	Syracuse
Hayes, M. R.	Syracuse	Syracuse
Highland Solar Salt Co.	Syracuse	Syracuse
Jaqueth & Co., S.	Syracuse	Syracuse
Lynch, Edward	Syracuse	Syracuse
Murray, C. B. & T. P.	Syracuse	Liverpool
Onondaga Coarse Salt Association[1]	Syracuse	
Pendergast, P.	Syracuse	Syracuse
Prell, M.	Syracuse	Syracuse
Salina Coarse & Fine Salt Co.	Syracuse	Syracuse
Salina Solar Coarse Salt Co.	Syracuse	Syracuse
Salt Springs Solar Coarse Salt Co.	Syracuse	Syracuse
Solvay Process Co.	Syracuse	Solvay
Turks Island Coarse Salt Co.	Syracuse	Syracuse
Union Coarse Salt Co.	Syracuse	Syracuse
Western Coarse Salt Co.	Syracuse	Syracuse
White, John & Co.	Syracuse	Syracuse
Schuyler co.		
International Salt Co.	Scranton, Pa.	Watkins
Watkins Salt Co.	Watkins	Watkins
Tompkins co.		
International Salt Co.	Scranton, Pa.	Ithaca
International Salt Co.	Scranton, Pa.	Myers
Remington Salt Co.	Ithaca	Ithaca
Wyoming co.		
International Salt Co.	Scranton, Pa.	Warsaw
Iroquois Salt Co.	Buffalo	Perry
Worcester Salt Co.	New York	Silver Springs

[1]A selling association, handling the output of the local producers.

SLATE

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Washington co.		
Algonquin Red Slate Co.	Truthville	Granville
Allen & Williams	Middle Granville	Middle Granville
Baker, Charles I.	Troy	Granville
Blanchfield, William	Salem	Salem
Bonanza Slate Co.	Granville	Granville
Edwards, Harry	Fair Haven, Vt.	Middle Granville
Granville Slate Co.	Granville	Granville
Herbert & Dietz	North Granville	North Granville
Manhattan Slate Co.	Granville	Slateville
Mathews Consolidated Slate Co.	Boston, Mass.	Granville, Middle Granville & Truthville
McCormick Red Slate Co.	Granville	Middle Granville
McDonough, John J.	West Pawlet, Vt.	Hebron
Montauk Slate Co.	Middle Granville	Middle Granville
O'Brien & Co., John W.	Middle Granville	Middle Granville
White, Charles N.	Granville	Slateville

STONE

Granite

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Clinton co.		
West Chazy Granite Co.	West Chazy	West Chazy
Essex co.		
Keeseville Village Quarry	Keeseville	Keeseville
Franklin co.		
Dubuque, Thomas	St Regis Falls	St Regis Falls
Fulton co.		
Adirondack Stone Co.	Gloversville	Gloversville
Brace, A. E.	Gloversville	Gloversville
Northville Granite & Marble Co.	Northville	Northville
Wright, John A.	Gloversville	Gloversville
Herkimer co.		
Halliman Bros.	Little Falls	Little Falls
Jefferson co.		
Boldt, George C.	New York	Alexandria Bay
Forsyth Granite Co.	Montreal, Can.	Thurso
Kapples, Thomas	Clayton	Grindstone
Packard & Kelly	Clayton	Clayton
Parry Bros.	Clayton	Grindstone
Picton Island Red Granite Co.	New York	Picton Island
Turcotte, Gordon O.	Grindstone	Grindstone
New York co.		
New York Botanical Garden	Bronx, New York	Bronx, New York
Orange co.		
Empire State Granite Co.	Paterson, N. J.	Pine Island
Pochuck Granite Co.	Brooklyn	Pine Island
Rampe Bros.	Pine Island	Pine Island

Granite (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Putnam co.		
Bailey, C. W.	Cold Spring	Breakneck
King, Frederick G.	Garrison	Garrison
Richmond co.		
Quinroy Contracting Co.	Port Richmond	Port Richmond
Rockland co.		
Clinton Point Stone Co.	New York	Iona Island
Rice Bros.	Suffern	Hillburn
Saratoga co.		
Ryall, Benjamin	Saratoga	Greenfield
Warren co.		
Reardon, C. J.	Glens Falls	Glens Falls
Westchester co.		
Ash, Edwin	New Rochelle	New Rochelle
Coleman, Breuchaud & Coleman	Croton-on-Hudson	Peekskill
Dobbs, Gilbert W.	Hartsdale	Scarsdale
Flannery, P. J.	Yonkers	Yonkers
Jerome Park Reservoir Quarry	New York	Jerome Park
Mohegan Granite & Quarrying Co.	New York	Peekskill
Nichols, W. H.	Hastings	Hastings
O'Rourke Bros.	Yonkers	Yonkers
Skipton, Pitt M.	New Rochelle	New Rochelle
Sleepy Hollow Monumental Works	North Tarrytown	Tarrytown

Limestone

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Albany co.		
Boughton, W. J.	Ravena	Ravena
Callanan Road Improvement Co.	Albany	South Bethlehem
Craw, Daniel H.	Ravena	Ravena
Harcourt Lime Works	Ravena	Ravena
Keefe, Daniel	Crescent	Dunsbach Ferry
McCullock, Conrad B.	Ravena	Ravena
Allegany co.		
Hunt, J. W.	Belfast	Belfast
Cayuga co.		
Auburn City Street Department	Auburn	Auburn
Beardsley, W. S.	Auburn	Auburn
Bennett, D. M.	Auburn	Auburn
Goodrich & Son, L. L.	Auburn	Auburn
Shalibo, Joseph L.	Union Springs	Hamburg
Smith, B. P., Estate of,	Union Springs	Union Springs
Wood, George P.	Union Springs	Hamburg
Chenango co.		
Woods, Theodore	Norwich	Norwich

Limestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Clinton co.		
Behan, Hugh J.	Plattsburg	Plattsburg
Chazy Marble Lime Co.	Chazy	Chazy
Gebs, Oliver	Plattsburg	Bluff Point
Movers & Co., J. B.	Plattsburg	Plattsburg
Columbia co.		
Hudson City Quarry	Hudson	Hudson
Dutchess co.		
Clinton Point Stone Co.	New York	Stoneco
Fuller's Sons, William	Albany	Crum Elbow
Hufcut, Mrs Alice G.	Dover Plains	Dover Plains
Lawler, Michael	Poughkeepsie	Poughkeepsie
Erie co.		
Akron Stone Co.	Buffalo	Akron
Appenheimer, John L.	Buffalo	Buffalo
Barber Asphalt Paving Co.	Philadelphia, Pa.	Buffalo
Board of Supervisors	Buffalo	Buffalo
Buffalo Cement Co., Ltd.	Buffalo	Buffalo
Buffalo Crushed Stone Co.	Buffalo	Buffalo
Carroll Brothers	Buffalo	Gunnville & Williamsville
Dickerson & Bell	Akron	Akron
Erisman, A. G.	Wilhelm	Wilhelm
Forest Lawn Cemetery	Buffalo	Buffalo
Gehres, Anna	Buffalo	Buffalo
Gesl, John, jr	Buffalo	Buffalo
Hiller, J.	Akron	Akron
Kieffer, Martin	Depew	Depew
Rupp, John J.	Buffalo	Kensington
Schreier, S.	Buffalo	Buffalo
Shoff, B. O.	South Newstead	South Newstead
Stanz, Ernest C.	Buffalo	Buffalo
Youngs, J. S.	Buffalo	Amherst
Essex co.		
Northern Iron Co.	Port Henry	Port Henry
Fulton co.		
Adirondack Stone Co.	Gloversville	Mayfield
Cristie, Edward	Mayfield	Mayfield
Haines, M.	Mayfield	Mayfield
Holmes, Frank J.	Mayfield	Mayfield
Kegg, Willard A.	Cranberry Creek	Cranberry Creek
Genesee co.		
Dawson, W. E.	Batavia	Batavia
Empire Limestone Co.	Buffalo	North Leroy
General Crushed Stone Co.	South Bethlehem, Pa.	North Leroy
Guttenbury, Theodore	Batavia	Batavia
Heimlech, John	Leroy	Lime Rock
Keeney & Son, N. B.	Leroy	Leroy
Morris & Strobel	Leroy	Leroy
Pongrazio, M.	Leroy	Lime Rock

Limestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Greene co.		
Day, Ambrose	Coxsackie	West Coxsackie
Driscoll, A. C.	Syracuse	New Baltimore
Haswell, W. T.	Climax	Climax
Holdridge & Son, George W.	Catskill	West Catskill
Massino, William	Smiths Landing	Smiths Landing
Mower, John	Smiths Landing	Smiths Landing
Palmer, W. S.	Catskill	Catskill
West Shore Stone Co.	Catskill	Catskill
Herkimer co.		
Higgins, Gilbert S.	Newport	Newport
Holland, George E.	Clayville	North Litchfield
Humphrey, J. W.	Mohawk	Columbia
Little Falls Stone Co.	Little Falls	Little Falls
Manning, A.	Columbia	Little Falls
Morey, Newell	Newport	Newport
O'Connor, George H.	Newport	Newport
Pierce, John	Little Falls	Little Falls
Salisbury, J. E.	Clayville	North Litchfield
Sherman, John	Newport	Newport
Smith, Clarence D.	Newport	Newport
Stillman & Spellman	Newport	Newport
Talcott, F. C.	Prospect	Prospect
Toomey, Daniel	Newport	Newport
Jefferson co.		
Adams & Duford Co.	Chaumont	Chaumont
Anthony, William	Cape Vincent	Cape Vincent
Babcock, L. M.	Watertown	Pamelia
Barron, John J.	Three Mile Bay	Three Mile Bay
Brennan & O'Brien	Watertown	Watertown
Clearwater, Victor	Watertown	Watertown
Cory, Henry S.	Watertown	Watertown
Doyle, William P.	Herring	Herring
Foster, Charles	Dexter	Dexter
Haley, Ward & Co.	Watertown	Watertown
Jefferson Power Co.	Black River	Herring
Lefave, George J.	Watertown	Watertown
Lingenfelter, Charles	Clayton	Clayton
Mayhew, A. V.	Watertown	Watertown
Miller & Son, Lott	Theresa	Theresa
New York Lime Co.	Natural Bridge	Natural Bridge
Shick, Clinton E.	Watertown	Watertown
Taylor, Andrew	Watertown	Pamelia
Lewis co.		
Babcock, H. A.	Lowville	Lowville
Babcock, William L.	Lowville	Lowville
Lashaway, Henry	Talcottville	Talcottville
Lyman, M. M.	Lowville	Lowville
Moren & Son, John	Lowville	Lowville
Post, Orville L.	Port Leyden	Port Leyden
Potter, M. N.	Lyon Falls	Lyon Falls
Schulz, Henry	Collinsville	West Turin
Siegel, John P.	Lowville	Lowville
Todd, J. B.	Lyon Falls	Lyon Falls
Tracy, Charles	Port Leyden	Port Leyden
Waters, John M.	Lowville	Lowville

Limestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Madison co.		
Adams, Frank D.	Munnsville	Munnsville
Chittenango Falls Park Ass'n	Cazenovia	Chittenango Falls
Conley, F. E. Stone Co.	Utica	Munn and Blakeslee
Hodge, Mrs Hattie C.	Perryville	Perryville
Mitchell, James H.	Canastota	Canastota
Tooke, D. J.	Chittenango Falls	Fenner
Winchell, W. M.	Chittenango Falls	Chittenango Falls
Worlock, Cyrus	Canastota	Blakeslee Station
Monroe co.		
Brown, H. S.	Rochester	Rochester
Casey & Murray	Rochester	Rochester
Foery & Kastner	Rochester	Rochester
Lauer & Hagaman	Rochester	Rochester
Whitmore, Rauber & Vicinus	Rochester	Rochester
Montgomery co.		
Allter Brothers	St Johnsville	St Johnsville
Amsterdam City Quarry	Amsterdam	Amsterdam
Casabonne, Germain	Amsterdam	Manny's Corners
Donlan, Thomas J.	Amsterdam	Amsterdam
Fitcer, C.	St Johnsville	St Johnsville
Hurst, Oliver	Amsterdam	Tribes Hill
Machold, Bernard	Amsterdam	Amsterdam
Mohawk Stone Co.	Palatine Bridge	Palatine Bridge
Nagle, Thomas	St Johnsville	Minden
Place, Daniel N.	St Johnsville	St Johnsville
Putnam, Willard	Akin	Tribes Hill
Ross, F. M. & M. G.	Amsterdam	Amsterdam
Schube, William	Akin	Akin
Shaper, A. E. & D. C.	Canajoharie	Canajoharie
Smith, W. Cassius	St Johnsville	Minden
Wemple Bros.	Amsterdam	Fort Hunter
Niagara co.		
American Stone & Lime Co.	Buffalo	Lockport
Bondinger, John	Lockport	Lockport
Buttery, Earl	Niagara Falls	Lewiston
Canal Quarry Co.	Syracuse	Lockport
Carl, A. R.	Lewiston	Lewiston
Crowe, Michael J.	Lockport	Lockport
Dean Co., F. E.	Niagara Falls	Niagara Falls
Glynn, Willard	Lockport	Lockport
Heary, M. F	Lockport	Lockport
Hoffman & Co., A. J.	Niagara Falls	Niagara Falls
Lockner, John	Lockport	Lockport
Lockner, William E.	Lockport	Lockport
Lockport Stone & Brick Co.	Lockport	Lockport
Muehlberger, Jacob	Lockport	Lockport
Shine, James	Lockport	Lockport
Stainthorpe & Co., C. N.	Lockport	Lockport
Verrity, Robert	Lockport	Lockport
Watson, T. G.	Lockport	Lockport
Whitmore, C. B.	Lockport	Lockport
Wilson, John H.	Lockport	Lockport
Witkof, Henry	Pekin	Pekin
Oneida co.		
Conley Stone Co., F. E.	Utica	Oriskany Falls
O'Leary, Jerry	Boonville	Boonville
Thomas, Clarence D.	Prospect	Prospect

Limestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Onondaga co.		
Alvord & Co., E. B.	Jamesville	Jamesville
Britton, S. E.	Syracuse	Onondaga
Burke & Burns	Jamesville	Jamesville
Costello, J.	Manlius	Manlius
Hayes Bros.	Split Rock	Split Rock
Heverin, Hugh	Skaneateles Falls	Skaneateles Falls
Hibbard, John P.	East Onondaga	East Onondaga
Hogan, Martin	Marcellus	Marcellus
Kelly, John	Syracuse	Onondaga Reservation
Malley, William F.	Marcellus	Marcellus
McLaughlin & Platt	Skaneateles	Skaneateles
Millen Co., Thomas	Jamesville	Jamesville
Onondaga County Penitentiary	Jamesville	Jamesville
Pallas, Theo.	Manlius	Manlius
Potter Brown Cement Co.	Manlius	Manlius
Rock Cut Stone Co.	Syracuse	Syracuse
Solvay Process Co.	Syracuse	Split Rock
Storrier, D. L.	East Onondaga	Indian Reservation
Terry, E. L.	Manlius	Fayetteville
Warner, Quinlan Co.	Syracuse	Syracuse
Wells & Son, Irving	East Onondaga	East Onondaga
Wolf, Andrew	East Onondaga	East Onondaga
Ontario co.		
Bacon, Orin S.	Canandaigua	Canandaigua
Johnson, William H.	Phelps	Phelps
Orange co.		
Burt, Thomas	Warwick	Warwick
Elston, L. J.	Pine Island	Pine Island
Harrison, John J. E.	Newburgh	Newburgh
Orleans co.		
Murphy, John	Holley	Clarendon
Staines, Thomas F.	Holley	Barre
Putnam co.		
Towner, James E.	Towners	Towners
Rensselaer co.		
Carey, Mrs William	Hoosick Falls	Hoosick Falls
Corliss Con. Co.	Troy	Troy
Dolin, John	Hoosick Falls	Hoosick Falls
McCaffrey, Cornelius	Hoosick Falls	Hoosick Falls
Rockland co.		
Tomkins Cove Stone Co.	Tomkins Cove	Tomkins Cove
St Lawrence co.		
Church, Ashley	Crary Mills	Crary Mills
Curran, John	Ogdensburg	Ogdensburg
Frank & Sons, Nathan	Ogdensburg	Lisbon
Leary, J. C.	Colton	Colton
Mainer, C. J.	Gouverneur	Gouverneur
Maroney, John	Ogdensburg	Ogdensburg
McConville, Joseph	Ogdensburg	Ogdensburg
Warren, H. H.	Massena	Norwood
Williams & Co., C.	Bigelow	Bigelow

Limestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Saratoga co.		
Callanan Road Improvement Co.	Albany	Saratoga Springs
Gailor, W. H.	Saratoga Springs	Saratoga
Slade, C. G.	Saratoga Springs	Saratoga
Smaldone & Bros., Paul	Saratoga Springs	Saratoga
Wagar, Isaac F.	Ballston Spa	Milton
Schenectady co.		
Flint Hill Stone & Construction Co.	Troy	Pattersonville
Schoharie co.		
Beard, F. P.	Cobleskill	Cobleskill
Becker, Clinton S.	Schoharie	Schoharie
Brandenstein Bros.	Cobleskill	Cobleskill
Cobleskill Quarry Co.	New York	Cobleskill
Dailey & Smith	Cobleskill	Cobleskill
Helderberg Cement Co.	Albany	Howes Cave
Merchant, Paul	Sharon Springs	Sharon Springs
Mix, Frank G.	Schoharie	Schoharie
Roberts, C. E.	Cobleskill	Cobleskill
Rogers, John C.	New York	Cobleskill
Ryan, P.	New York	Barnerville
Smith, Andrew	Sharon Springs	Sharon Springs
Smith, Jefferson	Sharon Springs	Sharon Springs
Smith, Willard T.	Sharon Springs	Sharon Springs
Seneca co.		
Babcock, Dwight	Waterloo	Fayette
Edson Crushed Stone Co.	Waterloo	Waterloo
Fisher, George M.	Seneca Falls	Fayette
Thomas & Bros., G. C.	Waterloo	Waterloo
Ulster co.		
Barley, Albert	Whitfield	Whitfield
Basten, John	Stone Ridge	Stone Ridge
Christianer, Nelson	Kerhonkson	Kerhonkson
Fiero, Nathan	Saugerties	Katsbaan
Hall, Lucian F.	Ellenville	Ellenville
Hornbeck, Charles B.	Wawarsing	Wawarsing
McNamee, Henry	Fly Mountain	Fly Mountain
Myers, Howard	Kingston	Ulster
Newark Lime & Cement Mfg. Co.	New York	Rondout
New York Cement Co.	Rosendale	Rosendale
Noone, Luke	Kingston	Kingston
Sayre jr & Co., James R.	Newark, N. J.	Kingston
Young & Humphrey	Napanoch	Napanoch
Warren co.		
Finch, Pruyn & Co.	Glens Falls	Glens Falls
Higley & Barber	Sandy Hill	Queensbury
Miller, Frank	Glens Falls	Queensbury
Nassivera, Joseph	Glens Falls	Sandfords Ridge
Reardon, C. J.	Glens Falls	Glens Falls
Sherman Lime Co.	Glens Falls	Glens Falls
Thomas, Sumner	Glens Falls	Glens Falls
Waite Lime Co., F. W.	Glens Falls	Glens Falls

Limestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Washington co.		
Adams & McKee	Whitehall	Whitehall
Bromley, Nelson R.	Sandy Hill	Sandy Hill
Callahan, J. J.	Whitehall	Whitehall
Cottrell, Horace	Greenwich	Middle Falls
Fenton, C. S.	Fort Ann	Fort Ann
Flood & Sherrill	Sandy Hill	Sandy Hill
Keenan Lime Co.	Smiths Basin	Smiths Basin
Kenyon, Ambrose	Middle Falls	Middle Falls
McGrouty, James	Greenwich	Greenwich
Nichols & Son, D.	Smiths Basin	Smiths Basin
White, C. H.	Comstock	Comstock
Wayne co.		
Hall, W. L.	Walworth	Walworth
Mather, E. B.	Sodus Center	Sodus Center
Walker, Charles J.	Wolcott	Butler
Westchester co.		
Clinton Point Stone Co.	New York	Verplanck
Ossining Lime Co.	Ossining	Ossining
Selz, Andrew	New Rochelle	Mamaroneck
Sing Sing Prison Quarry	Ossining	Ossining
Yates co.		
Seneca Lake Broken Stone Co.	Geneva	Dresden

Marble

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Clinton co.		
Burlington Marble Co.	Burlington, Vt.	Plattsburg
Lezotte, Peter	Plattsburg	Plattsburg
Columbia co.		
Jones & Co., F. W.	Greenport	Greenport
Dutchess co.		
Dover Chemical & Quarry Co.	New York	South Dover
South Dover Marble Co.	New York	Wingdale
Essex co.		
Lynch, Daniel	Minerva	Minerva
Lewis co.		
Sullivan, John J.	Harrisville	Harrisville
St Lawrence co.		
Clarkson Marble Co.	New York	De Kalb
Corrigan & McKinney	Cleveland, O.	Gouverneur
Ellsworth, Horace	Canton	Colton
Extra Dark Marble Co.	Gouverneur	Gouverneur
Gouverneur Marble Co.	Gouverneur	Gouverneur
Irving, A.	Gouverneur	Gouverneur

Marble (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
St Lawrence co., (*cont'd*)		
Leary, J. C.	Colton	Colton
Northern New York Marble Co.	Gouverneur	Gouverneur
Rylstone Co.	Gouverneur	Gouverneur
St Lawrence Marble Quarries	Gouverneur	Gouverneur
Watertown Marble Co.	Watertown	Gouverneur & Canton
White Crystal Marble Co.	Gouverneur	Gouverneur
Whitney Marble Co., D. J.	Gouverneur	Gouverneur
Warren co.		
Finch, Pruyn & Co.	Glens Falls	Glens Falls
Lake George Quarrying Co.	Glens Falls	Warrensburg
Langworthy, M. B.	Queensbury	Queensbury
Reardon, C. J.	Glens Falls	Glens Falls
Westchester co.		
O'Connell Lime & Marble Dust Co.	Tuckahoe	Tuckahoe
Ossining Lime Co.	Newburgh	Ossining
Waverly Marble Co.	New York	Tuckahoe

Sandstone

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Dutchess co.		
Clinton, Henry	Poughkeepsie	Poughkeepsie
Essex co.		
Bond, L. W.	Port Henry	Port Henry
Franklin co.		
Bashaw, Levi	Malone	Malone
Paddock, S. A.	Malone	Malone
Greene co.		
Fuller's Sons, William	Albany	New Baltimore
Smith & Post	Catskill	Catskill
Herkimer co.		
Kearney, Patrick	Little Falls	Little Falls
Jefferson co.		
Emery, Charles G.	Clayton	Clayton
Wilbur Estate	Clayton	Clayton
Monroe co.		
Rainesford, J. A.	Barnard	Barnard Crossing
St Bernard's Seminary	Barnard	Barnard Crossing
Montgomery co.		
Hillegas, C. M.	St Johnsville	St Johnsville
Hilliard, Alvin D.	Burtonsville	Charleston
Niagara co.		
Hotchkiss Estate, L. W.	Lewiston	Lewiston
Whitmore, C. B.	Lockport	Lockport
Oneida co.		
Conley Stone Co., F. E.	Utica	Higginsville
Thompson, C. F.	Washington Mills	Washington Mills

Sandstone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Orange co.		
Erie Railroad Co.	New York	Otisville
Orleans co.		
Fancher & Delaney	Albion	Albion
Farrand, W. H.	Holley	Holley
Filkins, S. E.	Medina	Albion
Ford, A. H.	Hulberton	Hulberton
Gorman, Charles A.	Medina	Medina and Albion
Kearney & Barrett	Medina	Medina
Le Valley, John	Shelby Basin	Shelby Basin
O'Brien, William	Holley	Holley
Orleans County Quarry Co.	Albion	Holley to Medina
Orleans Sandstone Co.	Syracuse	Hulberton
Perry, Fred	Medina	Medina
Reed, Allen & Reed	Albion	Albion
Ryan, M. A.	Medina	Eagle Harbor
Servasse, Joel	Medina	Shelby Basin
Squire, A. R.	Hulberton	Hulberton
Swett Iron Works, A. L.	Medina	Medina
Vincent & Co., Ed.	Hulberton	Murray
Whiting, Dr Chauncey H.	Medina	Medina
Oswego co.		
Ratigan & Co., John F.	Oswego	Oswego
Rockland co.		
Davidson Red Sandstone Co.	New York	Nanuet
Demerest, Perry E.	Haverstraw	Haverstraw
St Lawrence co.		
Clarkson Quarries, The	Potsdam	Potsdam
Downey Bros.	Fort Jackson	Fort Jackson
Edgar & Phillips	South Hammond	South Hammond
Flood, Dr J. Q.	Hopkinton	Hopkinton
Gibson, William	Hammond	Hammond
Potsdam Red Sandstone Co.	Potsdam	Potsdam
Saratoga co.		
Stiles, E. H.	Crescent	Crescent
Schenectady co.		
Kellum, George W.	Craig	Aqueduct
Shear & Co., Albert	Schenectady	Duanesburg
Ulster co.		
Davenport, Ira	St Josen	Kyserike
Warren co.		
Nassivera, Joseph	Glens Falls	Sanford Ridge
Washington co.		
Bromley, Nelson	Sandy Hill	Sandy Hill
Fenton, C. S.	Fort Ann	Fort Ann
Finch, Samuel L.	Sandy Hill	Sandy Hill
Gilbert, Martin	Comstock	Comstock
Holman Bros.	Fort Ann	Fort Ann
Stark, Charles	Comstock	Comstock
White, Henry F.	Comstock	Comstock

Sandstone (bluestone)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Albany co.		
Albany Bluestone Co.	Albany	Albany
Applebee, D. S.	Dormansville	Dormansville
Brate, D. W. & Son	Reidsville	Reidsville
Brate & Kline	Reidsville	Reidsville
Cummings Bros.	Voorheesville	Voorheesville
Filkins, Hiram D.	Reidsville	Berne
Stewart, Henry	South Berne	Westerlo
Allegany co.		
Burke, Michael	Black Creek	Belfast
Davis, William	North Cuba	Cuba
Gorton, Leander	Belmont	Belmont
Lang, Robert E.	Belfast	Belfast
Miner, C. J.	Belfast	Belfast
Searle, Abram	Rockville	Rockville
Smith, Frank S.	New York	Almond
Tracy, Solomon H.	Canaseraga	Angelica
Weir, H.	Belfast	Belmont
Wright, J. S.	Scio	Scio
Broome co.		
Deposit Stone Co.	Deposit	Deposit, Oquaga & Gulf Summit
Erie Bluestone Association	New York	Deposit & Gulf Summit
Kirkpatrick Bros.	Hancock	Deposit
Maden, P. J.	Deposit	McClure Settlement
Cattaraugus co.		
Brondart, William	Franklinville	Franklinville
Fate, J. J.	South Olean	South Olean
Rounds, Joseph	Olean	South Olean
Cayuga co.		
Cusack & Murray	King Ferry	King Ferry
Chautauqua co.		
Gould, Mary W.	Niobe	Niobe
Hayward, K. F.	Fredonia	South Fredonia
Jamestown Shale Pav. Brick Co.	Jamestown	Jamestown
Moore, George R.	Fredonia	Fredonia
Webster, Mary Jane	Niobe	Niobe
White, Squire	Fredonia	Fredonia
Chemung co.		
Symonds, A. D.	Elmira	Elmira
Chenango co.		
Bush, Thomas	East Guilford	East Guilford
Chenango Bluestone Co.	Norwich	West Hill
Clarke Bluestone Co., F. G.	Oxford	Oxford
Clarke, Conroy & Co.	Norwich	Norwich
Cummings & Johnson	Oxford	Oxford
Cushman, D. B.	Norwich	Norwich
Dunn & Mead	Oxford	Oxford
Hogan, Edward J.	Oxford	Oxford
Miller, William	East Guilford	East Guilford

Bluestone (*continued*)

NAME OF PRODUCER	POSTOFFICE	LOCATION OF QUARRY
Delaware co.		
Connor, M. L.	Walton	Walton
Cotter, E. J.	Hancock	Hancock
Erie Bluestone Association	New York	Hancock
Holbert & Maynard Bros.	Fishs Eddy	Fishs Eddy
Kazenstein, George W.	Hancock	Hancock
Kirkpatrick Bros.	Hancock	Hancock and Lordville
Lupton, Estate N. L.	Cooks Falls	Cooks Falls
Nevins Sons, James	Fishs Eddy	Fishs Eddy
Peak, Cyrus	Long Eddy	Hancock
Randall Bros.	Hancock	Hancock
Rhodes, John	East Branch	East Branch
Standard Bluestone Co.	Jersey City, N. J.	Hale Eddy and Lordville
Travis & Kingsbury	Hale Eddy	Hale Eddy
Erie co.		
Cook, William	East Aurora	East Aurora
Greene co.		
Smith & Yeager	Catskill	Kiskatom
Livingston co.		
Schumbmehl, Martin J.	Dansville	Dansville
Madison co.		
Loughlin, J. P.	Oneida	Oneida
Standt, George	Canastota	Canastota
Orange co.		
Davison, John G.	Monroe	Monroe
Otsego co.		
Adams, Edwin	Cooperstown	Cooperstown
Gazlay, Mrs Mary H.	Cooperstown	Middlefield
Ingalls Stone Co.	Binghamton	Oneonta
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New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

PUBLICATIONS

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Museum annual reports 1847–date. *All in print to 1892, 50c a volume, 75c in cloth; 1892–date, 75c, cloth.*

These reports are made up of the reports of the Director, Geologist, Paleontologist, Botanist and Entomologist, and Museum bulletins and memoirs, issued as advance sections of the reports.

Director's annual reports 1904–date.

These reports cover the reports of the State Geologist and of the State Paleontologist Bound also with the Museum reports of which they form a part.

Report for 1904. 138p. *20c.* Report for 1905. 102p. 23pl. *30c.*

Geologist's annual reports 1881–date. Rep'ts 1, 3–13, 17–date, O; 2, 14–16, Q.

In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899–1903. The two departments were reunited in 1904, and are now reported in the Director's report.

The annual reports of the original Natural History Survey, 1837–41, are out of print.

Reports 1–4, 1881–84, were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	*Price*	*Report*	*Price*	*Report*	*Price*
12 (1892)	$.50	17	$.75	21	$.40
14	.75	18	.75	22	.40
15, 2v.	2	19	.40	23	.45
16	1	20	.50	[*See* Director's annual reports]	

Paleontologist's annual reports 1899–date.

See first note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Those for 1901–3 were issued as bulletins. In 1904 combined with the Director's report.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882–date.

Reports 3–20 bound also with museum reports 40–46, 48–58 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3–4, 17 are out of print, other reports with prices are:

Report	*Price*	*Report*	*Price*	*Report*	*Price*
1	$.50	9	$.25	15 (En 9)	$.15
2	.30	10	.35	16 (" 10)	.25
5	.25	11	.25	17 (" 14)	.30
6	.15	12	.25	18 (" 17)	.20
7	.20	13	.10	19 (" 21)	.15
8	.25	14 (En 5)	.20	20 (" 24)	.40
				21 *In press*	

Reports 2, 8–12 may also be obtained bound separately in cloth at 25c in addition to the price given above.

Botanist's annual reports 1867–date.

Bound also with museum reports 21–date of which they form a part; the first Botanist's report appeared in the 21st museum report and is numbered 21. Reports 21–24, 29, 31–41 were not published separately.

Separate reports for 1871–74, 1876, 1888–96 and 1898 (Botany 3) are out of print. Report for 1897 may be had for 40c; 1899 for 20c; 1900 for 50c. Since 1901 these reports have been issued as bulletins [*see* Bo 5–8].

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have also been published in volumes 1 and 3 of the 48th (1894) museum report and in volume 1 of the 49th (1895), 51st (1897), 52d (1898), 54th (1900), 55th (1901), 56th (1902), 57th (1903) and 58th (1904) reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum memoir 4.

Museum bulletins 1887–date. O. *To advance subscribers, $2 a year or $1 a year for division* (1) *geology, economic geology, paleontology, mineralogy; 50c each for divisions* (2) *general zoology, archeology and miscellaneous,* (3) *botany,* (4) *entomology.*

Bulletins are also found with the annual reports of the museum as follows:

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2	51, v.1	4	" v.4	12, 13	" v.4	4	54, v.1
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7	50, v.1	5–7	" v.3	22	" v.1 "	Ms 1, 2	56, v.4
8	53, v.1	8	55, v.1	Bo 3	52, v.1		
9	54, v.2	9	56, v.3	4	53, v.1	*Memoir*	
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Pa 1	54, v.1	10	54, v.2	2	51, v.1		

The figures in parenthesis in the following list indicate the bulletin's number as a New York State Museum bulletin.

Geology. G1 (14) Kemp, J. F. Geology of Moriah and Westport Townships, Essex Co. N. Y., with notes on the iron mines. 38p. 7pl. 2 maps. Sep. 1895. *10c.*

G2 (19) Merrill, F. J. H. Guide to the Study of the Geological Collections of the New York State Museum. 162p. 119pl. map. Nov. 1898. [*50c*]

G3 (21) Kemp, J. F. Geology of the Lake Placid Region. 24p. 1pl. map. Sep. 1898. *5c.*

G4 (48) Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. 58p. il. 9pl. map. Dec. 1901. *25c.*

G5 (56) Merrill, F. J. H. Description of the State Geologic Map of 1901. 42p. 2 maps, tab. Oct. 1902. *10c.*

G6 (77) Cushing, H. P. Geology of the Vicinity of Little Falls, Herkimer Co. 98p. il. 15pl. 2 maps. Jan. 1905. *30c.*

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—— Drumlins of New York. *In preparation.*

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—— Geology of the Long Lake Quadrangle. *In preparation.*

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1 Beecher, C. E. & Clarke, J. M. Development of Some Silurian Brachiopoda. 96p. 8pl. Oct. 1889. *$1.*

2 Hall, James & Clarke, J. M. Paleozoic Reticulate Sponges. 350p. il. 70pl. 1898. *$1, cloth.*

3 Clarke, J. M. The Oriskany Fauna of Becraft Mountain, Columbia Co. N. Y. 128p. 9pl. Oct. 1900. *80c.*

4 Peck, C. H. N. Y. Edible Fungi, 1895–99. 106p. 25pl. Nov. 1900. *75c.*
This includes revised descriptions and illustrations of fungi reported in the 49th, 51st and 52d reports of the State Botanist.

5 Clarke, J. M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. 196p. 21pl. July 1903. *$1.50, cloth.*

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